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An Important Decision.

ELSEWHERE in this issue will be found a brief abstract of the opinion of the Supreme Court of the District of Columbia in the case of the application of Camille A. Faure for a patent upon the combination of the storage or secondary battery with a street-car motor. In this case the strong tendency recently exhibited by inventors, to claim exclusive rights over electrical devices commonly supposed to be public property, is repressed by the court, which refuses to see anything new in this combination, now in operation throughout the country. The electrical fraternity will have no criticism to make upon the result of this litigation, and a few will hope that a similar fate may in some way overtake the Forbes carbon-brush claim, noted in our columns some time ago; but we fear that many jurists will raise their eyebrows at some of the *obiter dicta* of the present opinion. "Hampering the success of electric locomotion" is not a legal consideration as to the validity of a patent, and the fact that "Mr. Faure will be remunerated for his labor" is, from a legal point of view, a mere flower that blooms in the spring. It is rather risky for judges to cover their natural innocence of electrical learning by interjecting apologies that smack of innocence of other kinds of learning as well.

A Hearty Endorsement.

THE movement in Chicago to place Mr. J. P. Barrett in charge of the electrical departments of the coming World's Fair is daily growing stronger. We are glad to see that the electrical fraternity is quick to appreciate the advantages of having a thoroughly unbiased practical electrician empowered to guard its interests. It is, of course, fitting that as the honorary scientific head of the electrical section some eminent scientific man should be appointed to preside over the conferences that will draw together *savants* from every part of the world; but for the all important executive portion of the work on which success so much depends, we must have an electrical man of affairs. It would be a most serious mistake to entrust these immense interests either to an inexperienced, though learned scientist, or to a practical engineer closely allied to any one electrical company.

Improving the Dynamo.

IT is a very remarkable fact, that in less than a score of years the dynamo should have reached so high a state of development that so far as efficiency is concerned there is little left to be done. The best dynamos to-day actually return as electrical energy more than ninety per cent. of the power used in driving them. Much beyond this we cannot hope to go, for we have no material of infinite conductivity, no insulator against magnetism, and no perfect lubricator. Even now, slight increase in efficiency is often gained at too high a cost in material and labor. But the dynamo is by no means perfect yet, and it behooves inventors not to sit down and wait for the much-rumored and never-seen methods of obtaining electricity direct from heat, but to sharpen their wits and go to work. And first of all let them turn their efforts against that root of all electrical evil, the commutator. It has no virtues to speak of, and is a most fruitful source of trouble. We already have alternating dynamos quite free from its malign influence, and it is high time we had a continuous currrent machine of a similar sort. The problem is difficult it is true, but there is no reason to think it impossible, and we commend it to the attention of the inventors who now fritter away their talents devising cruel and unusual forms of field magnets. The commutator must go.

"The Broomstick Train."

THE grimmest practical electrician who ever yanked at an obdurate trolley could not fail to smile over Dr. Holmes' spontaneous bit of fun at his expense in the current number of the *Atlantic*. "The Broomstick Train; or The Return of the Witches" is certainly a happy thought, and simply bubbles over with the good-natured wit that has endeared the now venerable poet to two generations. Certainly no neater satire on the electric car could be imagined than:

> "And as for the hag, you can't see her,
> But hark! you can hear her black cat's purr,
> And now and then as a train goes by,
> You may catch a gleam from her wicked eye.
> * * * * *
> Remember my rhymes when you ride again
> On the rattling rail by the broomstick train."

It surely will give a deal of satisfaction to the rural inquirers who glare wide-eyed at the uncanny-looking thing that whizzes by them to learn just how the motive power is applied, and the truth of the present hypothesis will be apparent to the most casual observer if he but contemplates the fact that the broomstick train has planted itself right in Salem, where it evidently belongs by the best of rights. Shades of Parson Parris! What sermons he could have written on such a text! And by the way, Dr. Holmes has evidently solved a great and perplexing philological difficulty by his happy suggestion. We have been waiting for months for some neat and appropriate designation for the man who operates an electric car. More barbarous words have been coined to meet this need than would suffice to start a new brand of Volapük. But our troubles are over at last, for if the electric car is a broomstick train, surely the presiding genius of the front platform must be a sweeper!

Storage Batteries.

THE elaborate paper of Prof. Ayrton, the first portion of which is given in the present issue, is a contribution to our knowledge of this very complicated subject so careful and thorough as to warrant more than ordinary consideration. At first thought it seems a very simple matter to measure the efficiency of a storage battery, but any one who attacks the problem practically soon finds it harder than he thought, for the battery has more different efficiencies than an arc lamp has candle powers. The total discharge that can be extracted from a secondary cell gives an efficiency far higher than can be obtained in any useful work, on account of the rapid fall in electromotive force that takes place in the latter stages of discharge. Besides this, the discharge of a storage battery depends not only on the previous charge, but to a certain extent on the previous history of the battery. Prof. Ayrton used the discharge under constant current as the criterion of efficiency in his experiments, and devised a very ingenious automatic apparatus to insure the fulfillment of this condition. The work on efficiency and the various complicated actions that make the subject so puzzling was carried out with the most painstaking care, and an amount of information has been amassed that makes the paper a most valuable one for reference. The exact chemical actions that constitute the processes of charging and discharging are as yet very imperfectly known, and it is decidedly agreeable to learn that this subject is now under active investigation by Professor Ayrton. We hope he will succeed in answering once for all the much vexed question as to the amount of "sulphating" that accompanies normal action.

Electrical Wonder-working.

APROPOS of the huge joke perpetrated recently in England, and mentioned in another column, we would advance the proposition that one of the chief ends of popular electrical education is to eliminate a certain sort of credulity. The popular idea of electricity is to look upon it as a mysterious force, coming from nowhere in particular, doing very nearly what it pleases, and equally able to produce a spark and a general disruption of the universe. There is a tendency on the part of certain people to contemplate it as an African does his gree-gree, a wonderful and ineffable something that need only be invoked to produce almost any result that can be named. This spirit has, perhaps, hastened the march of electrical industries, but it is certainly unworthy to encourage it. The sooner people are brought to look upon electrical power as only one of the Protean forms of energy, as subject to known laws, and quite transformable into other kinds of energy, the better for everybody concerned. To be sure we do not know what electricity is; in fact it is quite probable that it is not a separate entity at all, but on the other hand we do not know what the force we call gravitation is. Yet the actions of both under given conditions can be foretold with considerable accuracy, and perhaps we should not be able to do much more with them if Nature should yield up her profound secrets and set the unquenchable curiosity of man at rest. Look at electric energy as a force obedient to certain laws, known and unknown, able to accomplish much in skillful hands, but do not imagine it as ready to do all sorts of marvelous things without any particular method in its madness. Electrical education has done much to familiarize men with the correct ideas of the subject, and probably this diatribe can be taken as personal by very few of our readers. But the success of a hoax such as that to which we alluded teaches plainly enough that there is still much missionary work to be done.

High Speed Engines.

PROFESSOR THURSTON is so well known an authority on everything that pertains to steam engineering that his suggestive discussion of the modern engine published in another column cannot fail to attract wide-spread interest. The history of the steam engine is wonderfully instructive. Its growth from the rudimentary machine of Newcomen to the complex and wonderfully efficient triple expansion engine of to-day has been characterized by a series of spurts separated by periods when the art was almost at a standstill. The last of these sudden strides of improvement has given us the modern fast-running compound engine. So far as efficiency goes little is gained by the rise in speed, for the almost theoretically perfect cycle of curves given by the beautiful Corliss type of valve gear is equaled by few and surpassed by none of its speedier rivals. At very high speeds, above 500 revolutions per minute, for example, the indicator cards generally look ragged and misshapen, telling the story of wasted steam. But the gain in rapid and perfect governing, indispensable in many situations, has been great, to say nothing of cheaper construction and greater compactness. It must be remembered that no engine governs instantaneously. Even the best forms, for instance, are unequal to keeping rigidly constant voltage on a railway dynamo, though the higher the engine speed the more chances per minute to change the cut-off. And compounding has produced a very marked effect on the efficiency, saving, even when non-condensing, something like a quarter of the steam. This means a lessened coal bill, and when we pass to triple and quadruple expansions and add the condenser, the saving is immense. But we cannot improve indefinitely along this line; the time will inevitably come when increasing friction and complication will more than offset economy of fuel. For the future Professor Thurston has given us a glance at several interesting possibilities. Of course, a very high steam pressure would help matters, but thus far the enormous difficulties of lubrication at high temperatures have effectively blocked progress in this direction. But improvements may come nevertheless, and with high pressures will come in almost necessary sequence the checking of interior cylinder condensation by the non-conducting linings mentioned in the paper before us. For very hot steam means severe losses unless checked by such devices. And yet, with all these difficulties to be met, it is almost certain that the steam engine will be considerably improved. Electricians should take a keen interest in this problem, for, of all the machines with which they have to do, the steam engine is the most inefficient. If the chances of decreasing the losses in the engine were as small as they are in the dynamo it would indeed be a sorry outlook.

NEW BOOKS.

DICTIONAIRE D'ELECTRICITE ET DE MAGNETISME. Part 1, A, Electrolecteur, by Julien Lefévre. Pp. 256, 284 illustrations. Paris, Bailliere et Fils, 1890. $1.75.

The writer of a dictionary in nearly every case has before him a thankless and difficult task. He is constantly harassed by the knowledge that his space is limited and his time short, for labor as speedily as he may, changes come to destroy his peace of mind ere his book is off the press. And perhaps there is no subject so certain to grow right under the pen as modern electricity. The mass of matter that must be treated is enormous and it swells with a rapidity that defies all limitations. The present volume, bulky as it is, is barely one-fourth of the completed work.

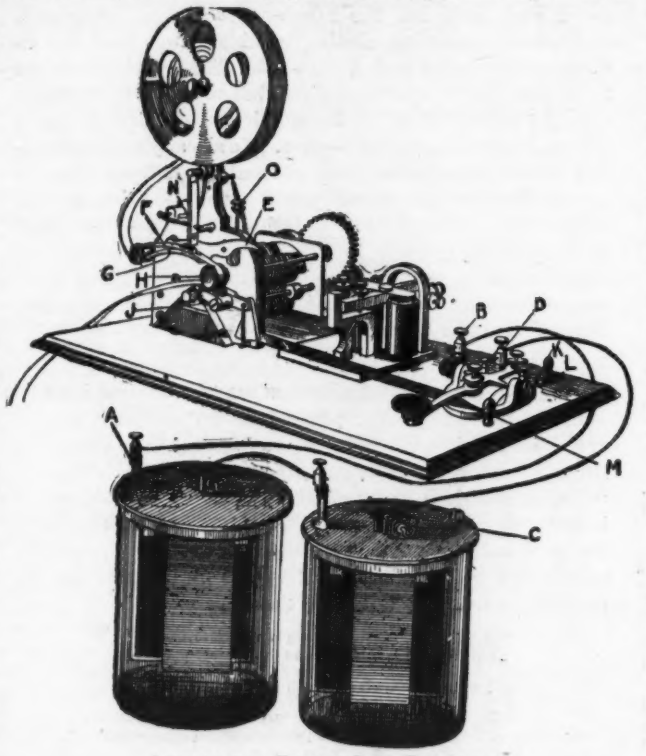
The line between dictionary and encyclopædia is a rather hazy one at best. Concise, clear cut and accurate definition and description of the things treated is usually supposed to be the attribute of the former, while more complete discussion of important topics is the province of the latter. Judged by this criterion one should not hesitate to class the work in hand as an encyclopædia, for it is vastly too diffuse for a dictionary, even of so broad a subject as electricity. And thus classified, it bears about the same relation to the complete and finished treatises, like that of Weidemann, that a cheap and popular encyclopædia does to the more dignified "Britannica." It is, in fact, hastily written, and bears distinctive marks of undiscriminating compilation. Nevertheless, it contains a vast amount of interesting and valuable matter, much of it inaccessible to electricians, in general. An immense number of terms are defined and explained in a clear and popular style. Its manner is somewhat too popular, in fact, in that exactness of statement is now and then sacrificed to vivid and picturesque coloring. Fairly lurid, for example, is the calm statement that high tension currents are dangerous on account of the induced currents formed in neighboring conductors. Almost as questionable is the brief notice of the therapeutic value of magnets, which rests on such very hazy and unsubstantial evidence that it is quite out of place in a statement of facts. There is, in fact, a most reprehensible tendency to devote valuable space and illustrations that might be useful to the description and exhibition of various electrical gimcracks and toys that possess a purely ephemeral interest and require no definition. The book is rich in illustrations of apparatus, and many accompanying descriptions are useful and to the point. In spite of its failings it certainly has a wide sphere of usefulness and contains an amount of general electrical information that makes it well worthy a place on the reference shelf. More exact and scientific books there are, but as a rule they do not concern themselves with commercial details to the extent desirable in a popular work. There are many small electrical devices of which one desires a description on file for reference, many phrases that will be clearer to the average mind by a well devised illustration. The chief value of the book under consideration lies, we think, in the immense variety of matter that has been gathered between its covers—we should not look to it for definitions written with crystalline scientific accuracy, nor for finished discussions of electrical problems, but rather for the many things that one, sooner or later, wants to find, and cannot secure in convenient form elsewhere. It is certainly a very convenient book to have at hand although it leaves much to be desired.

The New Thomson Dynamo.

A communication from Prof. Thomson gives some interesting facts concerning his new dynamo described in our last issue. It will be remembered that the principal electrical characteristic of the machine was absence of hysteresis in any marked amount, while the construction adopted possesses the great advantage of requiring no revolving wire. The construction of the machine has actually been simplified, even beyond the point shown in our illustrations, so that it is exceedingly easy to construct and prepare. Several have already been built—most of them of similar size and one of them for alternations as rapid as 2,500 complete reversals per second. The construction of the machine as a dynamo lends itself very easily to obtaining such high rates of alternation as are rendered highly desirable in certain classes of work. If the suggestion referred to some time since in our columns, of making transformers without iron cores, is ever carried out, this new Thomson dynamo should come into play with beautiful effect. Of course, in a converter without iron very high alterations are absolutely necessary to economical and efficient construction; but the advantages to be gained are great enough to make it a very interesting subject for experiment. In such case it should be noticed that any dynamo in which the magnetization of a considerable mass of iron is reversed at each alternation is practically excluded from use, since hysteresis would rise to an enormous amount, while the present machine, from almost complete absence of hysteresis, is admirably fitted for the purpose. A 1,000-light dynamo of the new form has already been constructed and is in process of testing. It has shown remarkably good results, and it is specially noticeable that the iron is free from heating, and the efficiency eminently satisfactory. A still larger machine is being planned, and there seems to be no good reason why the capacity may not be increased almost indefinitely.

An Automatic Telegraph Sender.

A very interesting and useful instrument is the one illustrated herewith. It goes under the name of the universal automatic telegraph sender, and its purpose is a double one—first, to facilitate the labors of the student of telegraphy, and, second, to afford a valuable means of self-improvement to those already expert in reading Morse. Reading by sound is not an easy art to acquire, and one of the special difficulties is that the sending usually first heard by the learner is apt to be not the smooth sending of the expert telegrapher but the painful efforts of other beginners. The difference is great, for while the first preserves the rhythmic sequence of regular telegraphic work, the second is apt to be disjointed and irregular, giving, therefore, very indifferent practice. It is a common experience of beginners, and especially amateur telegraphers, that it is almost impossible to work up to any respectable degree of speed without the assistance of a trained operator. It is this lack of proper instruction that the automatic telegraph sender is intended to supply, and it does it in a very perfect manner. The instrument itself is admirably shown in the cut, and consists, as will be readily seen, of the key, sounder and sending apparatus, which latter is actuated by the little electric motor within it. A reel above supplies the sending ribbon. This latter is embossed with the practice messages. The embossing machine is practically a rather powerful tape-receiving instrument with a multiplex stylus, so that instead of a single impression on the paper a series of parallel impressions



AUTOMATIC TELEGRAPH SENDER.

are produced which are quite deep, and consequently emboss the signals very sharply upon the paper. The office of this prepared tape is to open and close the circuit of the automatic sender by means of the embossments impressed upon it. To operate the instrument the end of the tape is passed from left to right between the brake *F* and the tape channel *G* over and around the wheel *H* and back between the wheels *H* and *J*. The embossments are placed upward on the tape channel. The transmitting lever, it will be seen, occupies an almost vertical position with its lower edge resting lightly on the tape with a pressure which can be nicely adjusted by means of the screw *N* controlling the spring. Whenever an embossed dot or dash touches the sending lever as the tape passes forward moved by the rollers, it makes contact and preserves it as long as the embossment is under the lever. It will be seen, therefore, that this sending lever is simply a key actuated by the raised portions of the tape and reduplicating in the most perfect manner the message originally impressed. At *K* and *L* is a simple switch which closes the motor circuit. The key should, of course, be closed by the lever *N* which automatically presses the wheels *J* and *H* together and starts the tape. The message impressed upon it will then be repeated in a sounder at any speed that should be desirable. The variation in rapidity is produced by a little brake on the fly-wheel of the motor. In learning telegraphy, then, the beginner is able to command a series of carefully planned practice messages sent in the most perfect manner at whatever speed its proficiency will allow. The sending is perfectly smooth and regular, with every dot and dash sharply marked and distinct; such sending, in fact, as would be received from an operator particularly expert in transmitting press matter. This power of heightening speed makes the instrument exceedingly serviceable to practical telegraphers who desire to become more expert in reading. Especially should it be of service in small local offices where the operators do not get a large amount of practice and are not used to encountering fast sending. The Electrical Novelty Company, of New York, has introduced this ingenious telegraphing machine. An indefinite number of prepared slips can be sent out from the central office and the most careful and thorough instruction given. It is worth noticing that the new instrument is simple, and not likely to get out of order, and that the battery power required to operate it is comparatively small, a couple of Edison-Lalande cells proving quite sufficient.

A Remarkably Successful Joke.

Perhaps as neat and effective a hoax as has amused the scientific world recently was the wonderful and altogether extraordinary electrophonoscope that the waggish propensities of Messrs. Preece and Hughes inspired them to elaborate for the Post Office Jubilee Conversazione, noticed in THE ELECTRICAL WORLD, July 12. The scheme was worked with a cleverness that could not have been greater had the parties to it been bent on pelf instead of fun. A speciously worded circular announced the exhibition of "this remarkable instrument" in terms that were simply captivating beyond measure, but the authors adhered rigidly to the truth and carefully abstained even from directly insinuating that electrical methods were used. The apparatus worked admirably, as indeed was inevitable, since it was simply the venerable contrivance of mirrors arranged to see around one or several corners, that has been known since the time of Hevelius. Standing at a telephone connecting with another room the experimenter not only heard the voice of the distant speaker but saw his face in the half light of a mysterious aperture that yawned above the receiver. The delusion was perfect and amazement and admiration were the order of the hour. But every one had come prepared to see something electrical and electrical everyone was determined it should be in the absence of any facts to the contrary. So the reporters rampant went home with their goosequills fairly itching to get at the unoffending paper and record another triumph of British ingenuity. With few exceptions, the daily journals jumped at the tempting conclusion like frogs at bits of red flannel, and were promptly booked. So much might have been expected, for the public is as prone to ascribe all marvels to electricity to-day, as it was to refer their origin to his Satanic majesty three centuries ago. But the two jokers met success beyond even their fairest expectations and they must have indulged in the "inextinguishable laughter" of which Homer sang, when they saw the remarkable effect of their prank on the technical press.

The principal London electrical papers escaped unscathed, but the small fry, and some large enough to know better, were with one accord taken in. As might have been expected, when it transpired that the supposed invention was a hoax, the victims were somewhat demoralized, and while some of them preserved a discreet silence, others waxed wroth and growled out protests.

But while the original report of the extraordinary apparatus flew to the very corners of the earth, the facts in the case, as usually happens, crawled slowly along in the rear. So it happened that the Continental and American papers were victimized in proportion to their credulity and lack of watchfulness. Of the American electrical journals, several were sadly bitten. One printed the first brief account as fact; another, more careful in watching the dispatches, noted the *exposé*, but refused to believe that such eminent gentlemen could joke, and confidently asserted that, coming from such authorities, there must have been a really great discovery, and the explanation must have been the humbug! But perhaps the most disastrous result was in the case of a learned and conservative French journal that solemnly presented a translation of the very suspicious sounding prospectus, and then gravely remarked: "If it fulfills its promises, the electrophonoscope will be one of the most brilliant discoveries of the century. This apparatus probably utilizes the electro-actinic properties of selenium."

Well, by this time the nature of the much-discussed apparatus is generally known, and everybody except the befooled journalists has had a laugh over it. Nevertheless it has a somewhat serious side that cannot quite be overlooked. It teaches us how easily the world can be humbugged if only the name of electricity be invoked to serve as a pretext for the marvelous. A certain proportion of mankind is quite ready to believe in electrical thaumaturgy of the most preposterous kind. It is not for those of us who have realized the wonders that electric science has wrought to set rigid bounds to its magnificent possibilities, but we must remember that it is not omnipotent and that some of the improvements of which we fondly dream may have to wait many years for their realization.

It is probably not safe to say that the problem of seeing by electricity cannot be solved, but it is nevertheless true that at present we neither know of an approximate solution, nor any line of investigation that gives a reasonable probability of obtaining one. The same is true of other questions often raised to-day. Some time the light may begin to break upon us, and then progress will, probably, be swift. Meanwhile it is well to keep eyes wide open for alleged inventions, quite as plausible and far less innocent than the one that formed the subject of the recent colossal joke of the learned gentlemen on the other side of the water.

The Electric Light Plant of the Progress Club.

Among the hundreds of isolated electric lighting plants now in use in the United States supplying hundreds of thousands of incandescent lights for a great variety of purposes, perhaps none are more noteworthy because of the care exercised in their installation and the first-class workmanship required than those which furnish lights for the prominent club houses in our large cities. A typical installation of this character, and one which possesses many features worthy of description, is illustrated on this page.

The plant is located in the magnificent new building of the Progress Club, on the corner of Sixty-third street and Fifth avenue in this city. The building occupies a prominent corner in a splendid part of the city, faces Central Park, and occupies a lot 100 feet square. The structure itself is 92 × 100 feet, is four stories in height and is very tastefully and very handsomely fitted throughout in the most approved style. The basement contains the billiard room, bowling alley and café, with steward's rooms, offices, etc. The main hall on the first story is 20 feet wide, and extends entirely through the building. On one side of it are connected library and drawing rooms, and on the opposite side a small dining room, committee rooms and offices of the club. The grand dining hall, an elegant room, is on the next floor above and is 90 × 55 feet. The floor above that contains the splendidly equipped and furnished ball room, as fine a one as can be seen anywhere in the country, measuring 90 × 65 feet and 35 feet high. At one end is a large gallery running the entire width of the room. Adjoining the ball room is a beautifully decorated ladies' parlor and a spacious hall, from which a grand staircase, with lights tastefully arranged upon the stair posts, leads to the floor below.

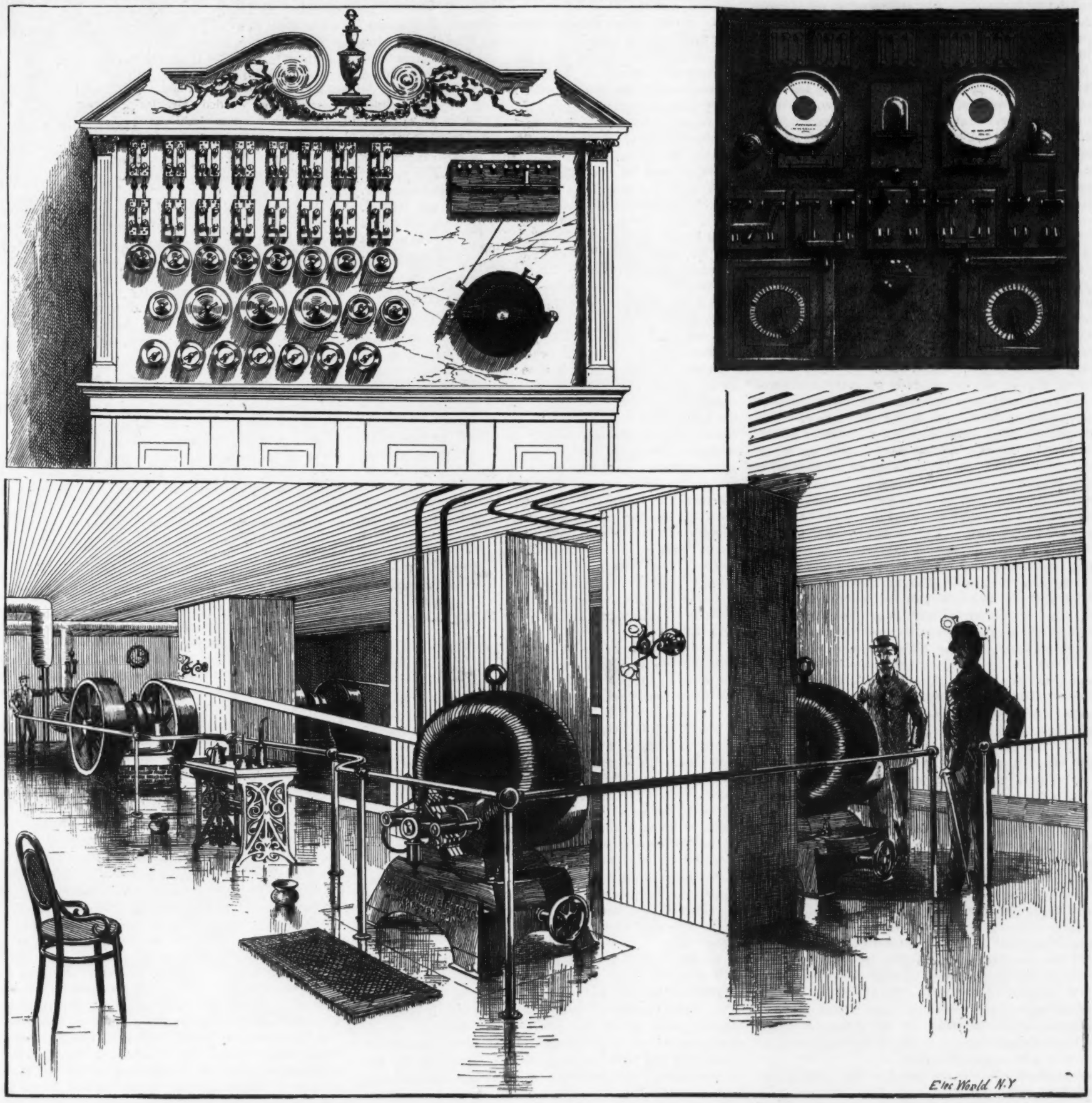
The electric light plant, which supplies current for 1,350 incandescent lights scattered throughout the building, is placed in an apartment beneath the basement. It was installed throughout, including the wiring for lights, electric bells and gas lighting apparatus, by the Tucker Electrical Construction Company, and has been completed and put in operation since last winter. In the dynamo room, which is shown in the lower part of the illustration, are placed two 650-light compound wound Mather dynamos, driven by two Armington and Sims high speed engines of 75 horse power each. The regulation of the dynamos is said to be admirable, a variation of only about one volt in the electromotive force being the result of a change from full load to a very light one. No sparking at the commutator is noticeable. The dynamos are set upon iron base frames resting on granite foundations, while the engines are erected upon brick piers. The best quality of leather belting is used to connect the engines and dynamos. The speed of the dynamo armatures is 900 turns per minute, while the engine speed is 260 per minute.

The dynamo switchboard is shown at the upper part of the cut on the right. Double pole knifeblade switches are arranged in such a way that either dynamo may be used alone to supply current to all the leads in the building, or both may be put upon the circuit in multiple. Safety fuses are provided and inserted, as shown at the top of the board. An independent ammeter is provided for each dynamo, and these, together with a voltmeter, are mounted upon the switchboard, which is made of solid slabs of slate. A small three-point switch is provided so that the circuit of the pilot may be connected across the terminals of either dynamo, or across those of both when the two are in service. The ordinary form of hand resistance box is used, and the two are shown below the switchboard.

The lighting of the magnificent ball room on the third floor deserves especial mention. No less than 540 lights are scattered about its walls and ceilings, and these are arranged with such artistic effect that the result obtained is all that could be desired, even in a room so exquisitely decorated. The lights are placed about the room in clusters, upon chandeliers, on wall brackets, in pockets, suspended on long, graceful stems, or grouped in many other ways. From the dynamo switchboard a special circuit leads to the switch-board in the ball room, which is shown at the left of the cut. This board is placed in the side of the room in a small cupboard which when closed is entirely unnoticeable. Its switches are over 20 in number and are mounted upon a marble base. By their use the lights to the various circuits of the ball room, its ceiling lights, wall bracket lights, stage lights or any others may be controlled independently. Rheostats are provided by which the candle power of the stage footlights can be varied if required.

The fixtures are especially unique and appropriate, in many cases having been designed to harmonize with the different style of decoration in which the rooms are finished. Those in the halls and stair-cases and some of the rooms are of wrought-iron in very handsome patterns. All of the standard electroliers and fittings were furnished by Schneider, Campbell & Co. of this city.

The wiring is very complete, switches being placed at all convenient points, usually in wall pockets. Over 50,000 feet of Grimshaw "white core" wire was used in the installation. Mr. Charles A. Gibson, formerly with H. B. Claflin & Co. in charge of their electric lights, is superintendent of the Progress Club plant, and the first class appearance of the machinery and lights and the excellent results obtained in the operation of the plant reflect great credit upon his management.



DYNAMO ROOM AND SWITCHBOARDS OF THE LIGHTING PLANT IN THE PROGRESS CLUB, NEW YORK CITY.

High Speed in Engines for Electric Lighting.

By Robert H. Thurston, Director of Sibley College, Cornell University.

Just a century ago, the "perfected" steam engine of James Watt had fairly conquered its place as a motor and as the great source of power for the growing industries of the world. Although Watt was not "the inventor of the steam engine," as he has been so often and so generally denominated; and although Newcomen and Cawley were its inventors, if we consider the steam engine as a train of mechanism, and not the old eolipile forms, as the germ of the modern machine; Watt, as the great improver and introducer of the engine, deserves all the honor that later generations have accorded him. The invention of the details of the modern engine was sufficient to entitle him to all this, even had the machine done vastly less for the race than it has actually accomplished; but the benefit conferred was largely through the action of secondary and resultant developments. The wonderful expansion of the world's industries during the intervening century has been very largely, if not mainly, due to the provision, by Watt and his contemporaries and successors, of a powerful, convenient, economical and manageable source of power. The most striking phenomenon of the century, to the social and the political economist, has been this enormous development of a thousand new industries, of many thousands of new products of industry, and the extraordinary diversification of the skilled vocations of mankind. All this is to be recognized as consequent, very largely, upon the production by the great inventor of a suitable source of energy and power.

Since the days of Watt, there has been no industrial development even approximately as important as the now familiar and almost matter-of-course introduction and extension of the various applications of the power of steam through the intermediary of the electric current as its strong and far-reaching right arm. The growth of steam engineering during the last decade or more has been almost as great and as wonderful as during the earlier days of the development of the Watt engine. The use of the electric light and of electric power transmission, as in the use of motors and on street railways, and the many minor applications of electricity have compelled the expansion of many old lines of business most remarkably, and have accomplished even more remarkable things in the institution of new kinds of production. The glass-blower has been called upon to produce innumerable new forms, and to resort to numberless new and ingenious processes, to meet the exacting demands of the engineer; the worker in brass and in bronze, in fine iron work and in all departments of light toolwork, has been called upon to modify and to improve his methods, and to invent and apply a thousand new devices to the purposes of this latest of all the departments of engineering.

The maker of wire has been forced to seek the finest and purest copper, and to draw it into wire, harder, stronger, and in greater lengths, than it was ever before supposed possible to secure; new kinds of insulation, new systems of support and of preservation, have come into use, each improvement bringing after it a long train of minor or accessory inventions, discoveries, and improvements. Innumerable new forms of dynamo-electric machines, each specially and precisely adapted to a certain prescribed purpose, generators and motors of once unimagined perfection and efficiency; with, for each one of them, a host of little improvements and inventions in detail, have set the world agog with their work, have made the engineer wonder at their ingenuity, and have puzzled even the man of science and the professional electrician by the delicacy and subtlety of their theory, and by the variety and singular characteristics of their interacting currents and forces.

Finally, the steam engine itself has been given new forms to meet the requirements of this imperative new master. We propose briefly to consider the latest modifications of the engine, giving a concise and untechnical account of its special peculiarities, and the principles of its construction and application, as dictated by the new purposes to which it is sought to apply it.

There are two principal characteristics that distinguish the machinery employed for electrical distribution of energy from most other kinds of apparatus driven by the steam engine. The speed of rotation is unusually high, and the regularity of its motion, to insure satisfactory results, must be made extraordinarily perfect. To these two essentials all other considerations are subsidiary. In the various forms of machinery employed in the arts, outside this department, the first demand of the prime mover is generally economy of operation, and the exactness of its motion is a secondary, though often important, desideratum. In the most exacting work, that of cotton machinery producing fine goods, it has been thought that the regulation of the engine driving it should be made sufficiently perfect to keep the fluctuations, with usual variations of loads, within about one per cent. of the mean and within a total range of two per cent.; but, in electric lighting machinery, the range considered allowable is oftener half these figures, and some makers guarantee that the fluctuation shall be imperceptible, from full load to no load. The usual speed of the main line shafting in mills and in shops is rarely above 200 turns per minute, while, in the dynamo, the range is from about 1,000 on those of moderate size and of special types, up to 2,500 and 3,000 in extreme cases; while some are constructed to turn very much faster than the latter, even. The engine demanded of the trade for these latter purposes, therefore, must be capable of regulation to within perhaps one-half the range of the older types, and must be fitted to couple directly to machinery having five or ten times the speed of rotation of ordinary mill machinery. This demand, exacting as it is and seemingly impossible to meet, as it would have been thought not many years ago, has been satisfactorily fulfilled by a number of inventors and constructors.

The difficulties to be encountered in the attempt to comply with such conditions can hardly be realized by those unfamiliar with the steam-engine and its development. It was at once evident that the speed of rotation must be increased, and the ideas of Charles T. Porter, who had, as early as 1860, shown that speed is an element of economy, and had begun to exploit a "high-speed" engine, seeking economy in that manner, were recognized as elements of the new form of engine. In the days of Watt, the speed of rotation had rarely, even with small engines, exceeded 50 revolutions per minute; and Mr. Corliss considered that a speed of 75 revolutions was about as high as his tripping mechanism would ordinarily allow; but Porter went up at once to 200, and the Corliss engine is now sometimes driven at over 100 revolutions per minute. The modern high-speed engine goes far above these figures, however, and 300 revolutions is thought a very fair, but not radical, limit. In a few cases, as in engines of Ericsson and others built for special applications, this speed has risen to as high as 1,000, and even, with very short strokes of piston, experimentally to over 2,000.

Some of the conditions of success in the attempt to solve this great problem are sufficiently evident.* The obviously essential high speed of rotation of such engines can only be attained by simplifying the construction of the machine just as far as practicable, and by discarding the "trip cut-off" and adopting some "positive motion" valve gear. But the trip was considered the vital element in the regulating mechanism of the older engines, as it allowed the governor to do its work without introducing irregularities in its action through resistances coming from the valve motion. Porter adopted a "positive" and then secured good regulation by the use of the powerful loaded governor, in the form now so well known by his own name. Hartnell and Guthrie, the inventors of the device in England, and Hoadley, the first to use it in this country, by adopting the now almost universally employed "shaft governor," gave to all later makers the means of solving this problem most satisfactorily, enabling them to use the simplest possible valve gear and yet to obtain a good distribution of steam and the most perfect regulation at the same time—conditions formerly considered absolutely incompatible.

It is practicable to make the "detachable" valve gear operative up to speeds even exceeding 100 revolutions per minute; the shaft governor is adapted to velocities of 200 turns and upward; the higher the better. At 300 revolutions a minute, a common speed with this class of machine, it is possible to regulate, by nice adjustment, to within a range of one-half of one per cent. This has been attained in engines tested by the writer, and may be attained by careful manipulation of the best high-speed engines of almost any well-known makers. This solves the second of the prime requisites – the first from the point of view of application, perhaps—that of exact regulation. No system of electric lighting can be satisfactory in which the fluctuation of speed of engine can be observed at the lamp, in its varying intensity. Such fluctuation cannot be perceived where restricted to a fraction of one per cent, nor can it practically interfere with good work when kept well under two per cent., the once accepted limit.

Economy comes in as a third requirement of the new type of engine. The older "simple" engines were expected to give the horse power on an expenditure of not more than three pounds of good coal per hour, if non-condensing, and about two pounds if condensing; which corresponded to about twenty-five or seven pounds of steam for the first, and perhaps twenty pounds for the second class, with the best modern boilers, economizers, and heaters. But the older types of engine had a great advantage in their admirable systems of valve gearing which gave an equally excellent steam distribution; the separate steam and exhaust valves, separated ports, and quick cut-off all conspiring to enable the engineer to secure the closest possible approximation to the perfect ideal which is essential to maximum efficiency. The use of a single valve, in the high-speed engine, restricts him very seriously, and compels a certain loss of efficiency. From 30 to 50 per cent. more steam was thus at first used in these engines. Good proportions of valve and of gearing, amply high speed of rotation—itself an element of economy—and practically frictionless and "isochronous" governors were brought out; but the machine still remained a less economical heat engine than the older type, and in most instances, seriously so. The source of this waste and the methods of its prevention were promptly made the subjects of investigation, and the wonderful inventive faculty of the American engineer was set at work to devise improvements.

* Stationary Engines for Electric Lighting. By R. H. Thurston. New York: J Wiley & Sons. 1890. (New edition.)

The cause of waste was very quickly detected in the large amount of "internal condensation" or "cylinder condensation," as it has come to be called, which was consequent upon the high heat-conducting power of the metal of which the cylinder is composed, and the exaggeration of this loss which comes from the increased proportion of surface exposed to weight of steam passed through the engine, as sizes are diminished. The increased speed of engine had diminished its size for a given power, and this had, in turn, with the less effective steam distribution, produced a large percentage of waste. The amount of this loss varies, in ordinary good practice, from about 25 or 30 per cent. in an engine of about 200 i. h. p., to 40 or 50 per cent. with engines of 50 h. p. of the same make, and to 60 or 70 per cent. in engines of from 1 to 5 h. p.* The remedies previously found effective in the prevention of waste were, however, well understood, and were promptly put into practice by the more enterprising builders. These are three in number: 1. Increasing the work of the engine in such manner that the amount of condensation in the unit of time being given, its proportion to the quantity of steam used in the engine in the same time should be reduced. 2. Superheating the steam, thus reducing its capacity for wasting heat in the engine. 3. Compounding the engine so that the waste of the one cylinder might be utilized in supplying the demand due to waste in the succeeding cylinder.

The first of these methods had been found effective, but the new engine was precluded from resort to this expedient from the fact that it was already constructed for as high speed as was found practically safe and satisfactory. The second device was known to be effective; but, while every builder endeavored to secure dry steam, with more or less success and without meeting with serious embarrassment, the attempt to use superheated steam had been shown, by many years of experience, to be invariably attended with more or less risk to boilers and engine, and with considerably enhanced cost of maintenance. On the whole, superheating had never become a successful and accepted method of increasing economy, though well known to be in theory and in practice a most efficient means of reducing these internal wastes. A half century of experimental use, under all known conditions, had not given it permanent place among the standard expedients for securing maximum economy of steam and of fuel, even though endorsed by the highest of European authorities, M. Hirn. A few great designers and builders, as Corliss and Leavitt in this country, and Cowper and a few others in Great Britain and on the continent of Europe, had, in special cases—usually in steam pumping engines—made good use of the device; but these instances were rare, and the system was, and is, but slowly gaining ground.

Compounding, on the other hand, had been practiced from the days of Hornblower, the rival of Watt. At first entirely unsucessful, the gradual rise of steam pressures, the gradual increase of the ratio of expansion, and the continually increasing demand for economy in use of fuel and of steam, gave this system a stronger hold as the years went by, and it at last became, a generation ago, a somewhat common method of construction of large engines for important work, and has now become the universal system in marine engineering, and in some departments of stationary engine building, as in pumping engines and the finer class of mill engines of large power. It was not quite understood, however, until recently, by the average practitioner, what were the real causes of its efficiency, and it was not known whether it would pay to employ it in small engines. This last doubt was promptly removed upon trying it, and the "high speed compound engine" is rapidly becoming the standard engine for its special field of work. It was found that the total gain in the best constructions, due to compounding, amounted to something like one-third on engines of large power, and often to one-half with the smaller sizes. This made the difference between success and failure, in many cases, and with a handsome margin on the right side. Nearly all builders promptly took up the system, after the first experimenters had gone ahead.

So far as now known, there are but two ways in which further improvements can be effected. The speed is at a limit beyond which it is expected to go but slowly as methods of construction are improved, and as the attendants become accustomed to management of the new engine; the regulation is as near perfection in the best engines as is either desired or expected; and simplicity of construction can hardly be carried further; indeed the symptoms are rather that we may see a reaction in the direction of a multi-valve distribution in some cases.

The economical use of steam is still far from that indicated by theory as the ultimate. The engine above referred to demanding from 25 to 70 pounds of steam per h. p. per hour, as actually built in the various sizes specified, should, if the ideal conditions could be attained, give its power at the rate of less than 18 pounds. The best engines built to-day, of any type and of highest duty, have an ideal expenditure of about 8 or 9 pounds of steam per h. p. hour, while they actually employ from 13 pounds upward. The two ways in which these losses, of a third or more, can be further reduced, so far as now known, are increasing the temperature, and, perhaps, the pressure of the steam used, and the production of a non-conducting

*Philosophy of the Compound Engine; Trans. Am. Society, of Mechanical Engineers, 1889; Journal Franklin Institute, Dec. 1889.

and non-radiating surface within the cylinder of the engine.

Superheating the steam was shown by Hirn to be the best and most philosophical method, provided it could be made practicable from the constructor's point of view. This has not yet been generally practiced, but it is not improbable that it may be done with good design and construction of the superheating apparatus and proper management of the engine. Its use would render the jacket superfluous, as it is known that the latter has no appreciable effect where the steam is kept dry in the cylinder. No wastes are left that it can affect. It would substitute for the disadvantages of the jacket, as a matter of construction, those of the superheating system. The latter have formerly been the greater; but it does not follow that they will continue to be so. A good superheater, and a good cylinder lubricating system for high temperatures, would accomplish this end. These should certainly be within reach of the inventor and constructor.

The securing of non-conductivity of the internal heat-wasting surfaces of the cylinder would not seem absolutely beyond our reach. A century ago, Smeaton, the greatest engineer of his day, in part accomplished this result by the use of a sheathing of wood on his pistons and cylinder-heads. This cannot be done with the high pressures and temperatures of steam usual to-day; but other plans may prove feasible. Mr. C. E. Emery, many years ago, tried enameling these surfaces, and with enough success to show that the idea is a good one; though the enamels and coverings then available were not suitable for this purpose. The writer has found a method patented by him some time since similarly effective and possibly practicable, and doubtless other inventors will turn their attention to the problem, ultimately with complete success.*

Could a material be found of sufficient strength and a good non-conductor, of which the steam cylinder could be made, this result would be reached, and the efficiency of fluid of the ideal engine would be practically attained.

Like the best engines of other types, the modern high-speed engine now seems to have been brought, in its best forms, to so perfect a condition that the range for further improvement is probably very narrow, and the gain still to be made must come slowly and painfully. In regulation and in simplicity of construction, in speed of rotation and in general adaptation to its special work, it is comparatively satisfactory. The further improvement must be in economy of its operation and maintenance. Greater efficiency of the working fluid will be gained, as in all other heat-engines, by increasing the temperature of the steam; higher efficiency of the engine as a machine will follow more effective ways of reducing engine friction; but the compounding of the engine must be taken as the last large economical step in its improvement.

The problems now arising in its application are those which come to the engineer in all departments of his work.

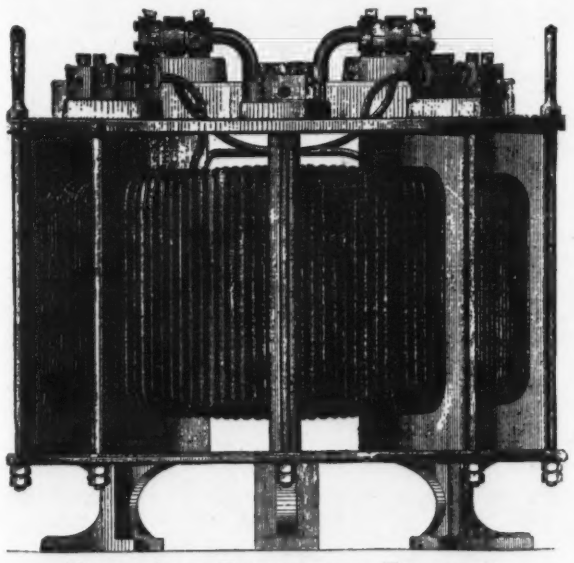


FIG. 9.—GANZ TRANSFORMER—ELEVATION.

He must decide what efficiency he can afford to pay for in increased cost of engine; what size of engine he should adopt for a given amount of work; what size of "unit" of power he may best adopt in dividing up the work, if he is to divide it at all, among several engines, and what each subdivision of power should measure. In general, it is now well understood that the engine should be given a lower ratio of expansion than was formerly supposed economical under specified conditions.† The ratio should rarely, probably, be greater than three or four in simple non-condensing engines, and at less than 100 pounds pressure, or greater than six or seven in simple condensing engines. Compounding enables the engineer to design his engine with a view to expansion down to a terminal pressure—in the latter case of, perhaps, 10 pounds—economically.

* My plan consists in dissolving the iron from the surface of the parts exposed to the action of steam, as the faces of the piston, the interior of the heads and the ports, by the use of acid, thus leaving a thin covering of reduced conductivity; which surface is then, if desired, filled with a still better non-conductor, as the resin of a drying oil, with which it may be saturated. The experiments of Prof. R. C. Carpenter and of Mr. P. M. Chamberlain, indicate that this may effect a saving of a large fraction of the now seemingly unavoidable interior wastes.—*Trans. Am. Society of Civil Engineers*, 1890 (*Cresson meeting*).

† For a study of this subject in somewhat wide relations, see papers on "The Several Efficiencies of the Steam Engine," Trans. Am. Society Mechanical Engineers, 1882, and Journal Franklin Inst., 1882.

The unit of power adopted is made the largest at which the engine can be continuously employed in its regular duties, and for some hours together. Every case, and especially in electric lighting, compels the designer to study the problem from many points of view, and to compute probable expenditures and minima of costs for a variety of possible arrangements, before he can finally safely decide just what system to employ or what type of engine is likely to prove best for the intended establishment and plant. Mr. Field's work at the Edison station in Brooklyn, and that of Mr. Henthorn in Providence, are good examples of this problem, carefully worked out, while the plans of the West End Company in Boston, and many of those produced by Mr. Sprague, illustrate the solution of similar problems in street railway work.

Electrical Distribution by Transformers from Central and Eccentric Stations.*

BY DR. J. A. FLEMING.

Ganz Transformers.—Proceeding next to the transformers, we may mention, in passing, the old life-buoy shaped transformer of Zipernowski merely to point out

FIG. 8.—ZIPERNOWSKI TRANSFORMER—OLD FORM.

that it is no longer used in practice. In that early form the primary and secondary coils were wound in circular coils, then laid together, and wound over with iron wire so that the whole arrangement looked like a stout circular ring. (See Fig. 8.) This form possessed a multiplicity of disadvantages. The heat generated in the coils themselves escaped with great difficulty. The magnetic resistance of the iron circuit was considerable, and any damage to the coils or insulators could only be repaired by taking the whole apparatus to pieces with great labor. Hence this type of shell transformer gave way to a more practically useful form. In the latest form, a series of sheet-iron discs like flat thin rings, are stamped out; these are built up with interposed paper layers into a circular ring of laminated iron, having a square or rectangular cross section. These discs are held together by radially placed clamping plates (see Fig. 9), which divide the ring core into partitions. The primary coils are then wound on the ring, covering it uniformly, and the secondary wire is put outside the primary. Iron discs top and bottom enclose the core and serve as supports for the terminals and fuses. The transformer roughly resembles a water-wheel, and can be rolled about easily when set on edge. On the top plate are fixed porcelain discs, which carry the primary and secondary fuses, which are short slips of fusible metal contained in glass tubes. The transformers are made in various sizes, to transform down generally to 105 and 52 volts, and each secondary circuit has three terminals by which 105 volts can be taken off for incandescent lamps, and 52 volts for arc lamps. The transformers are made in four sizes as follows:

GANZ TRANSFORMERS.

No.	Output in watts.	Weight in kilogrammes.	Commercial efficiency at full load as given by makers.
1.....	1,875	70	92.5
2.....	3,750	110	94.5
3.....	7,500	180	95.5
4.....	15,000	290	96.8

The energy loss in magnetizing the iron is stated to be 5.5, 3.5, 2.5 and 1.5 per cent., respectively, at full load in the No. 1, 2, 3 and 4 sizes, and the energy loss in the copper is put at 2 per cent. The primary coils are wound to receive current at 900, 1,800, 2,700 and 3,600 volts respectively in the four sizes, and to transform it down to 105 and 52 at the chief and intermediate terminals on the secondary circuit. The relation in commercial efficiency to the load on the secondary circuit of watts is given by the efficiency curve, as shown in Fig. 10.

This curve is given only on the authority of the manufacturers, but its general accuracy is probably sufficient for the purpose of reckoning the efficiency of the transformer at various loads. It has been confirmed fairly well by the independent tests made by the Frankfort-on-Main Committee in 1890. This committee found that the latest pattern of Ganz transformer had at full load an efficiency of 95 to 96 per cent., at half load 93 to 94, at quarter load 90 and at eighth load 80 per cent. efficiency. (Lon. *Electrician*, Vol. XXIV., 1890 p. 439.) The experiments of M. A. A. Roiti,* to be again referred to later on, have also shown the efficiency at full load of a 3,800-watt Ganz transformer to be from 94 to 96 per cent.; but we defer to another chapter the full discussion of the methods by which these values have been arrived at. It is desirable, however, to make here a brief reference to some misleading conceptions which often surround the question of the efficiency of transformers in practical use. It has been frequently pointed out that there is a great difference between the instantaneous efficiency of a transformer at any moment, and the mean efficiency over any period such as 24 hours, during which it is loaded to various degrees. The difference between these efficiencies may be considerable, the mean efficiency being often very much less than the maximum efficiency, and depending on the way in which the transformer is used. Given, however, a definite load curve—that is, a curve showing the load in watts on the secondary of the transformer at short intervals of time during the day, and an efficiency curve such as that in Fig. 10—the mean efficiency may be deduced as follows:

Let the ordinates of the firm-line curve in Fig. 11 represent the secondary load in watts, or the lamp-load on the transformer, at the various hours of the day. Increase each hourly ordinate of this curve in the ratio of 100 to the number denoting the efficiency of the transformer corresponding to the actual secondary load at that hour, which can be done from the efficiency curve giving the relation between efficiency and secondary load. Also if at any hours the secondary circuit is open and the secondary load therefore zero, ordinates must be set up at these points on the same scale proportional to, and representing, the power in watts absorbed by the transformer when the secondary circuit is thus open. Let the new higher ordinates define a curve shown by the dotted line. Then the ratio of the whole areas included between the two curves, firm and dotted, and the base line, is a fraction which denotes the *mean efficiency* of the transformer during the 24 hours. If the load diagram varies from day to day, a further comparison of the daily mean efficiencies must be made to obtain the real average mean over any period of time, such as a year. It follows that a high efficiency at full load will not give a high mean efficiency unless the efficiency curve of the transformer rises from zero very rapidly to its greatest ordinate. A transformer may have a very high efficiency at full load; but if it absorbs, when the secondary circuit is open, a sensible amount of power, and stands idle 20 hours out of 24, its real commercial efficiency may be brought down easily to 60 or 70 per cent. or less. Further remarks on the bearing of this fact on the economy of working of transformer stations will be reserved until later. In central station work done by this firm the 7.5 unit, or 7,500 watt transformer, is a very favorite size. The usual practice with Messrs. Ganz & Co. is to "bank" a number of transformers when a large secondary output is required, so arranging them that the primary circuits are all in parallel between the primary mains and the secondary circuits all in parallel with the secondary mains, and then to connect or disconnect transformers according as a larger or smaller output is required. In placing the transformers four methods are adopted. The transformer when one only is required at a place can be placed on a shelf inclosed in a weather-tight iron box (see Fig. 12), or it may be perched up on an iron pole like a dovecot, an ornamental form being given to the transformer case (see Fig. 13), or it may be buried in a water-tight iron box (Fig. 14); or some small fireproof dry room in the building to be supplied with current may be set apart as a transformer house, and in which the transformers are arranged on porcelain insulators, on stone or wooden shelves, or resting on iron rails. This latter plan has much to recommend it in the facility it affords for getting at the transformer.

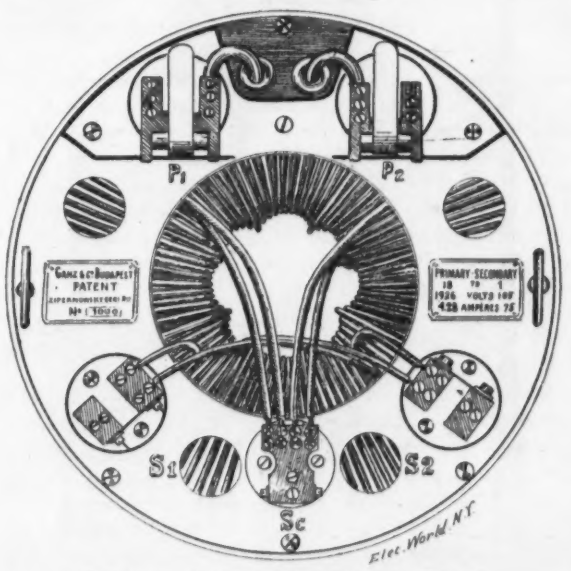


FIG. 9 A.—GANZ TRANSFORMER—PLAN.

Pressure Regulating Devices.—If an alternating-current dynamo is supplying current to a group of distant transformers through a cable laid between the localities, and if the load on the secondary circuits of the transformers varies, then the primary current flowing through the sup-

* Continued from THE ELECTRICAL WORLD, July 26 and Aug. 2, 1890.

*See *La Lumière Electrique*, March 15, 1890, Vol. XXXV., p. 525.

ply conductor will vary also. In order that the electric pressure at the terminals of the secondary circuits of the transformers may be kept constant in value, it is sufficient and necessary that the pressure between the primary terminals of the transformers be maintained at a constant value. Assuming that the primaries of the transformers are arranged in parallel between the primary conductors, it follows that whatever may be the variation in the primary current, the pressure between the terminals of the primaries of the transformers must remain the same. If the resistance of the cable is R ohms, and its self-induction negligible, and if V is the potential difference between the terminals of the alternator and v is the potential difference between the terminals

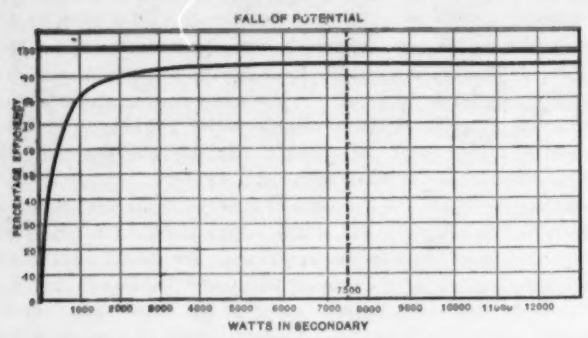


Fig. 10.—Efficiency Curve of Ganz Transformer, Showing Efficiency in Per Cents in Terms of Secondary Load.

of the primary coils at the far end of the cable, then the current in the cable in ampères is approximately equal in magnitude to $\frac{V-v}{R} = C$. Hence, we have $v = V - C R$, and if v is to be kept constant, then it follows that as the strength of the primary current C varies, the potential difference at the terminals of the alternator must vary also, but so that the quantity $V - C R$ remains constant in value. The pressure at the terminals of the alternator must, therefore, not be maintained constant, but fluctuate with every change in the load on the tranformers at the far end of the cable. It has already been pointed out that with the arrangements adopted by Messrs. Ganz & Co. this can be achieved by regulating the strength of the field-magnet current of the excitors, and MM. Zipernowski, Déri and Bláthy have devised an exceedingly ingenious method for regulating automatically the magnetizing current of the excitors in such a manner that the quantity $V - C R$ is kept constant for all values of the secondary loads. The arrangement adopted is called an automatic regulator, and is placed in the central station in some convenient position. It is diagrammatically represented in Fig. 15. A is the alternator, and L_1 L_2 the primary leads, or cable proceeding out from the station. In some convenient position in the station are placed two transformers, T_1 and T_2, called respectively the shunt and series transformers. The primary circuit of the transformer, T_1, is placed in parallel across the leads L_1 L_2, and the primary of the transformer, T_2, is placed in series in one of the leads, L_2. The secondary circuit of T_2 is closed through a suitable resistance, R_2, and the secondary circuit of T is closed through a solenoid S, and resistances R_1 and R_2 as shown; the transformers T_1 and T_2 being so joined up that the secondary electromotive forces in T_1 and T_2 oppose one another as far as producing a current in the solenoid S is concerned. The potential difference between the terminals e and d of T_1 is proportional to the potential difference V between the terminals of the alternator. The potential difference between the points a and b is, or can be, made nearly proportional to the magnitude of the primary current in L_2, and hence to the fall in volts along the cable or to $C R$. Hence the potential difference between c and b or between e and f can be made proportional to $V - C R$ or to v, the primary pressure at the primary terminals of the transformers. If a voltmeter Vl is joined up between e and f, this voltmeter can be made to read the same value as a voltmeter placed across the secondary terminals of the transformers ot the far end of the line. For this pressure at the secondary terminals is proportional to v, the pressure at the primary terminals. Hence the voltmeter Vl can read the pressure at any instant on the lamp circuits, although it is in no way connected directly with them. This voltmeter always indicates a pressure proportional to $V - C R$, which quantity it is necessary to keep constant.

The solenoid S is therefore traversed by a current, which is thus controlled in strength by the outgoing main current C and the terminal pressure V of the alternator. This solenoid is traversed by a tube or rod, partly of iron and partly of brass, the iron part so situated that a current in the solenoid tends to draw it up into the solenoid. This rod is held between guide pulleys, so that it can move quite freely through the solenoid. It carries at its upper end a glass cup full of mercury, and at its lower end is a metal float, by means of which its weight is taken up when the float is immersed in a vessel of water. The diagram in Fig. 16 shows clearly the nature of these arrangements. Above the mercury cup is situated a resistance coil of iron wires, and the terminal wires of the sections into which this coil is divided are brought down into a group of iron wires beveled off like pan-pipes, and so fixed in a block as to dip into the mercury in the cup (B, Fig. 16). It is easily seen, therefore, that as the mercury cup rises and falls it immerses a greater or fewer number of iron wires, and more or less of the coils on the resistance coil will be short-circuited by this immersion. This resistance coil is in the circuit of the field-magnet coils of the excitors; and hence as the mercury cup moves up or down in obedience to a greater or less attractive force of the solenoid upon the iron rod carrying that cup, so the field strength of the excitors is varied.

The connections are made so that if the current in the solenoid circuit, which is proportional in strength to $V - C R$, increases, the mercury cup is drawn down, and so intercalates resistance in the fields of the excitors and decreases the strength of the field of the alternators, and *vice versa*. There is a small rheostat or resistance T in series wish the solenoid S, by which large variations of the current in the solenoid can be made by hand, and in the same way large amounts of variation of the fields of excitors can be made by a hand-regulated resistance; and the automatic arrangements then can be set to keep the pressure at the far ends of the feeders constant within a given amount, so as to be independent of the changes of load. The above arrangement may seem at first rather complicated, but it does its work in practice very well, and its practical operation shows it to be one of the few devices of this kind which can be considered to be a thorough success.

The above described elements constitute the distinctive features of the transformer system elaborated by MM. Zipernowski, Déri and Bláthy, and we proceed to describe some of the central stations operated by the aid of these devices.

(To be continued.)

A Successful Continental Tramway.

It is interesting to note that at least one electric road abroad has met with a degree of success that is most encouraging, and ought to stimulate further enterprise of the same sort. The road in question is located in Buda-Pest, was designed and constructed by Messrs. Siemens and Halske, and was formally opened in September last. During the month of April of the present year it carried 337,200 passengers, or 42,684 passengers per kilometre, the line being 7.9 kilometres in length. There were 20 motor cars in daily use, excepting on Sundays and holidays, when four additional cars were called into requisition which were attached to four of the motor cars. The city possesses a horse tramway of 45.6 kilometres length, and 329 cars, which carried in the same period 33,074 passengers per kilometre, or 9,610 less than the electric tramway. Calculating the "duty" for each vehicle, it will be found that each electric motor car carried 16,860 passengers, whereas each horse car carried only 4,584 persons in the same period. The fares on the electric tramway are considerably lower than on the other lines, yet during the month mentioned the earnings of each electric car came to 1,022.95 florins; the horse car, on the other hand, earning only 369.81 florins. These figures would show that the commercial efficiency of the electric cars is much higher than that of the horse cars, and it is explained that this is mainly due to the much greater speed (18 kilometres per hour) of the former, which more than doubles the earning capacity of the line. The proportion was even greater in May last, when 337,000 passengers were carried on the electric tramway.

No exact figures for the working expenses have been made public, but they are reported as lower than with horses. All this is rather an old story to us in America, but coming as it does from another and more conservative country, it shows there as here that the horse car must go before long.

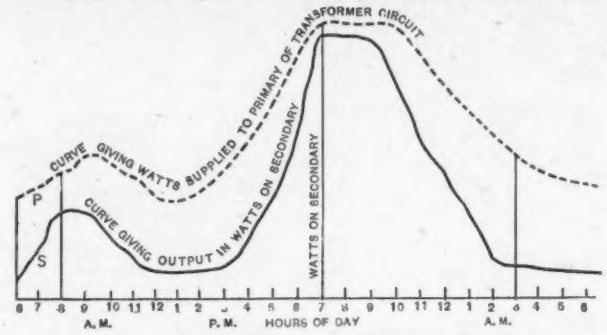
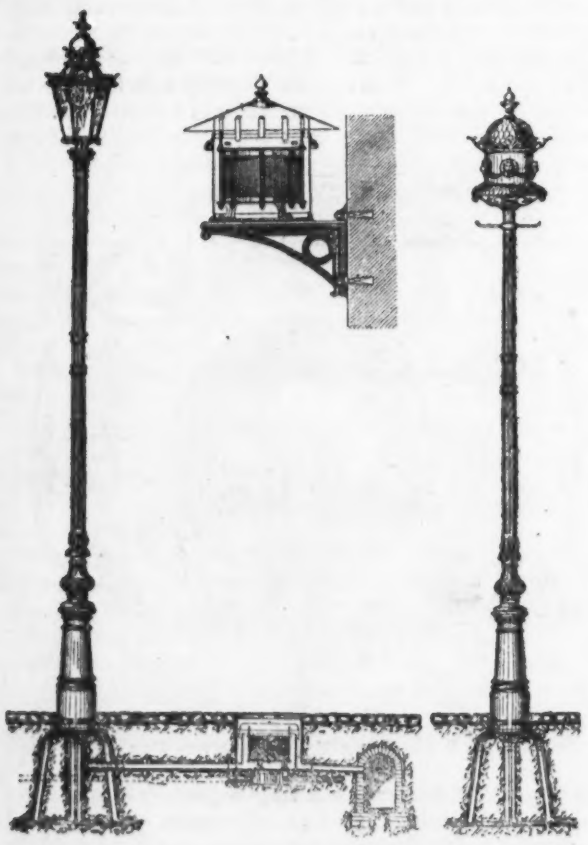


Fig. 11.—S is a Curve Showing Hourly Variation of Load on Secondary Circuit in Watts. P is a Curve Showing Corresponding Variation of Watts Supplied to Primary Circuit.



FIGS. 12 13, 14.—ARRANGEMENT OF GANZ TRANSFORMERS.

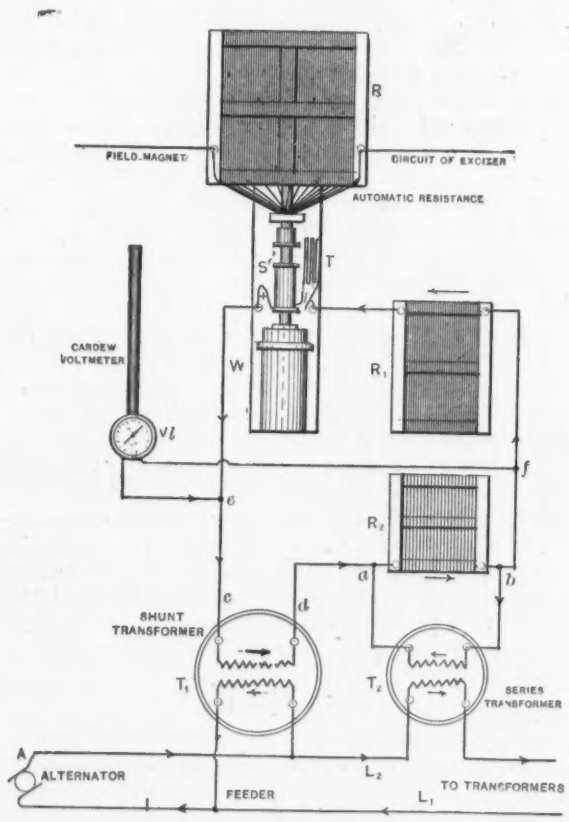


FIG. 15.—PRESSURE REGULATING DEVICES—GANZ SYSTEM.

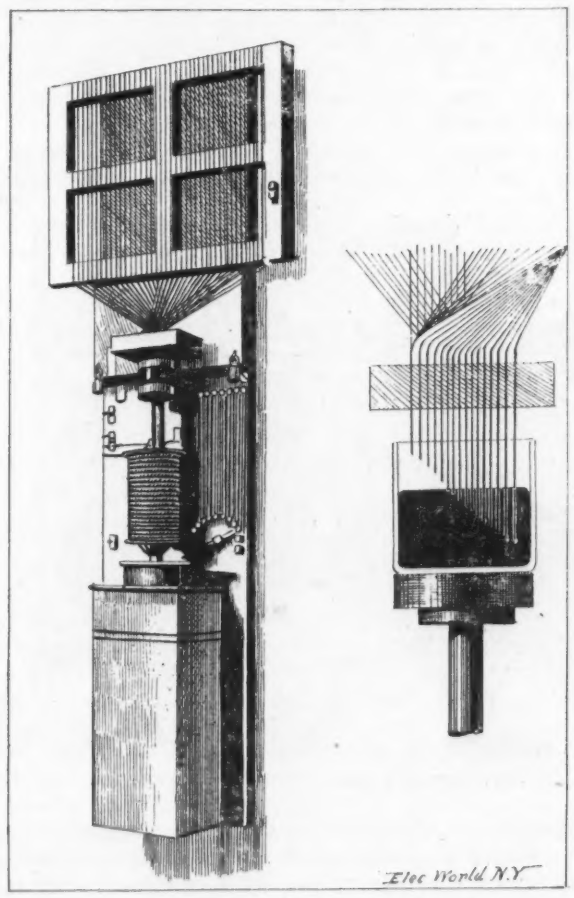


FIG. 16.—DETAILS OF GANZ PRESSURE REGULATOR.

The Chamberlain Battery Rack.

Great interest has been excited by the perfection which has been attained in the operation of substituting charged for discharged secondary batteries employed in the installation of the United Electric Traction Company, at its station, corner of 85th street and Madison avenue, in this city. The bringing of the work to its present complete form is due to Mr. J. C. Chamberlain.

The visitor at the station is surprised at the rapidity and ease of the operation of shifting the batteries. A car having discharged batteries is run into the station and into a kind of stall between two racks of superimposed shelves; there is a sort of sliding noise, a movement of the elevator platforms on each side of the car, and the car is rapidly run out, leaving the station within three minutes after entering. In that time a complete set of batteries, having a charge sufficient to carry the car on its journey to the post office and return, has been substituted for the exhausted batteries, and the latter have been automatically connected into the charging circuit on the racks and are again being charged.

The general construction of the racks and hoisting mechanism is shown in the accompanying illustrations. Fig. 2 is a side view of a rack and hoisting mechanism, and Fig. 1 a vertical transverse section, with the car in position. The racks have a number of shelves superimposed, as shown, and adapted to receive the drawers of batteries. When the batteries are in place on the shelves they automatically make connections with the charging dynamos, which are not shown in these illustrations. A large number of cells may be packed within the limited floor room taken up by these racks, which are placed far enough apart to receive between them a street car, and usually also the hoists. The floor space occupied is but 24 by 7 feet on each side of the car, and there are contained within this space cells enough to do the work of from 130 to 150 horses, which may be fairly said to represent the stall room these horses would require, about 6,000 square feet. The hoists are usually arranged between the racks and the car, and the hoists on the opposite sides of the car are independently operated by electric motors; these motors, however, are only used in elevating the platforms. For lowering them to any place desired opposite the racks or the car an ingenious friction brake in the elevator winch is used. By throwing off the motors and allowing the hoists to drop under the control of the friction brakes a considerable saving of time is effected. A charged set of batteries is loaded on the upper platforms of the hoists, in readiness for an incoming car. When the car is run into the stall, the cove panels are quickly dropped to form a bridge to the lower platform of each hoist, which has been brought into position, as shown at the right hand of Fig. 1. The discharged batteries are pulled out from the car, over this bridge, on to the lower platform, the hoist then dropped to the position as shown at the left hand in Fig. 1 and the charged batteries are shoved into place on the car; the panels are closed automatically, and the car moves out; the hoists are then raised, the discharged batteries on the lower shelves are run onto vacant shelves at the same height on the two racks, and the top platform is re-loaded with charged batteries for the next car.

The shifting can be done rapidly by means of one man on each side, who stands on the platform shown in the cut, which is connected by ropes with the hoist on each side, so as to rise and fall with the latter, and so be always in position opposite the hoist at whatever part of the rack it may be.

The system has been patented by Mr. Chamberlain, in the United States and foreign countries, the foundation patent having been issued on May 6, 1890, and a patent covering certain improvements being shown in a recent issue of the *Official Gazette*.

The details of the construction have been well worked out. Fig. 3 illustrates the form of binder, also patented by Mr. Chamberlain, which is used for connecting adjacent

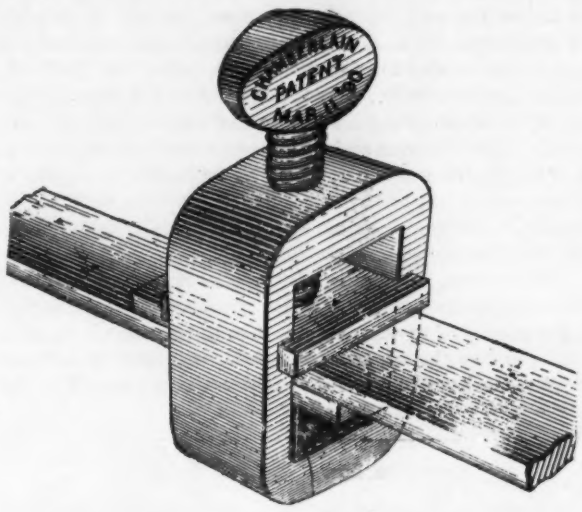
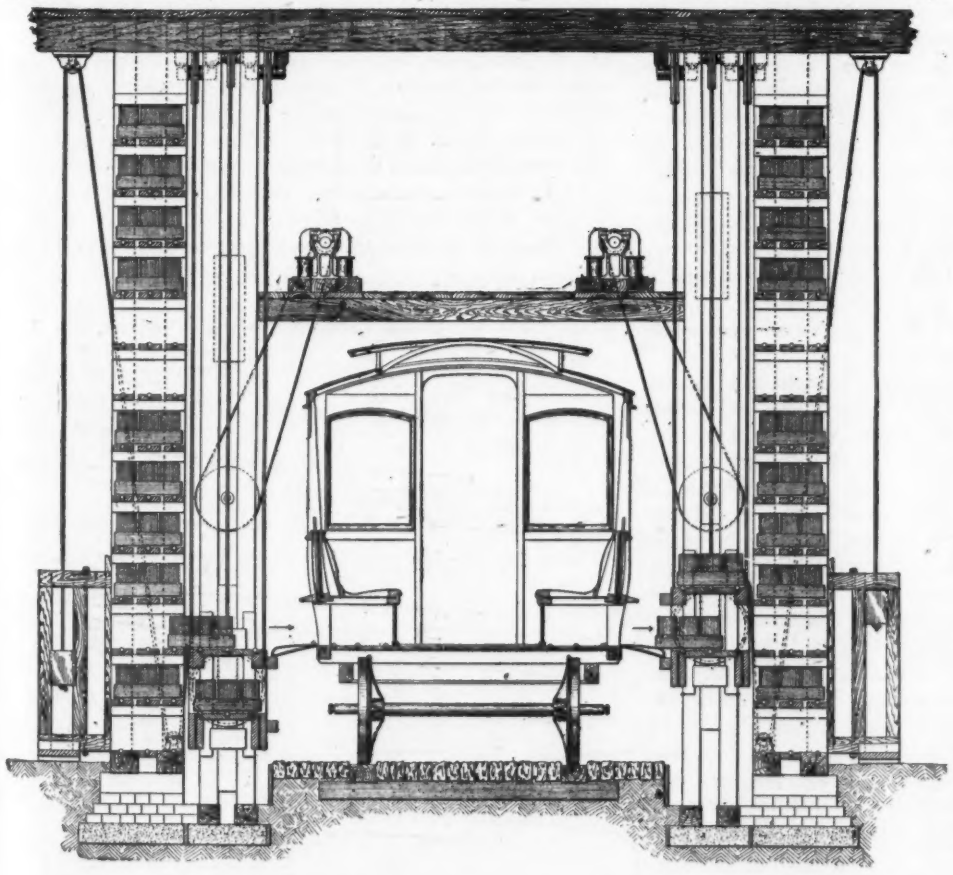
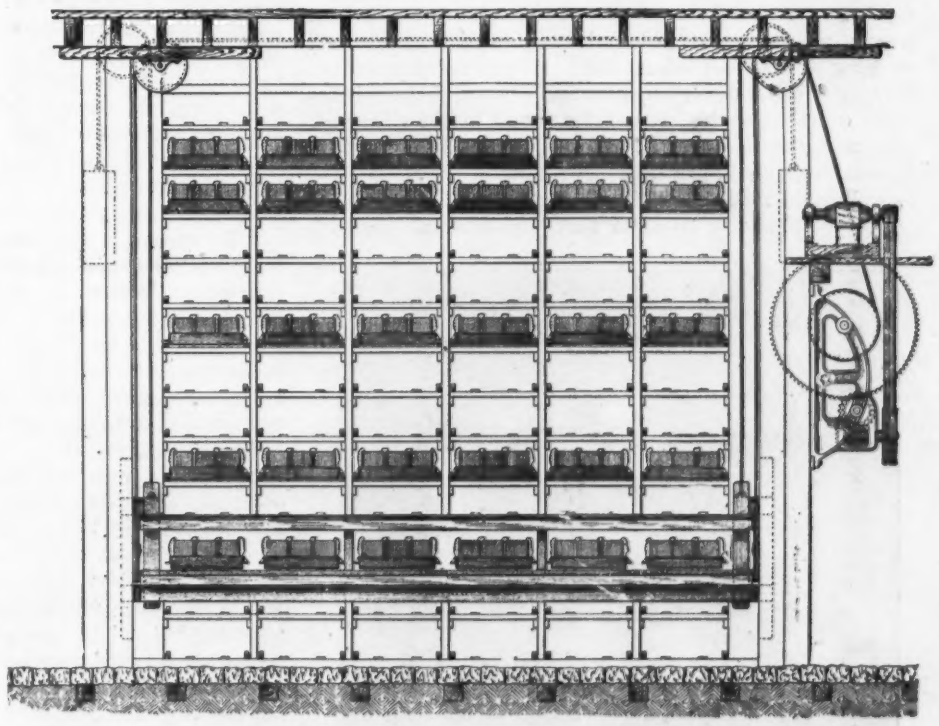


FIG. 3.—CHAMBERLAIN'S CONNECTOR FOR BATTERIES.

ends of the two cells of the batteries. It is important that single cells shall be coupled rapidly and removed without disturbing the remaining cells in the same drawer; and also that good electrical contact shall be maintained between the electrode terminals, which are connected by the binder. Mr. R. N. Chamberlain is to be credited in part with the solving of this problem. Advantage is taken of the binding action of a hard rubber screw, in a socket of the same material. Referring to the figure, there is a loop of hard rubber, adapted to receive two ends of the electrodes of adjacent batteries, which are shown in the cut. A rubber cushion is arranged at one end of the loop, and a hard rubber washer and hard rubber screw at the other end. By turning the thumb-screw the battery terminals are pressed tightly together between the hard rubber washer and soft rubber cushion. The rubber cushion insures the maintenance of such pressure as to prevent any turning of the thumb-screw or loosening of the electric connection.





FIGS. 1 AND 2.—TRANSVERSE SECTION AND SIDE VIEW OF THE CHAMBERLAIN BATTERY SHIFTING MECHANISM.

New Insurance Rules for Electrical Installations.

Copies of the new rules and regulations advised by the Boston Manufacturers' Mutual Fire Insurance Company for the installation of electric lighting and motive apparatus are now ready for distribution. These rules have been jointly adopted by the above company, by the Boston Fire Underwriters' Union and by the Electric Mutual Insurance Company. They were prepared by Messrs. C. J. H. Woodbury, F. E. Cabot, C. M. Goddard and S. E. Barton.

The preface to the circular contains an admirable testimonial as to the safety of electric lighting plants when properly installed. It says: "It may be stated that when electric lighting was first introduced, many years since, in mills or works insured by this company, mainly on the arc system, we had 23 cases of fire in 61 installations, but without any loss, within six months from the beginning. During that period the subject was thoroughly investigated and rules were prepared, by which all our members have been governed since that time; the rules now presented are a development rendered necessary by numerous inventions and improvements in the applications of electricity to illumination and to the transmission of power. There has not yet been a loss from any fire which could be attributed to electricity, generated for purposes of lighting or for motive power, in any mill or works insured by this company. The experience of ten years has sustained our position that a well installed electric lighting system is the safest method of illumination."

The Faure Secondary Battery Decision.

The Supreme Court of the District of Columbia has decided the case which was brought to it on appeal from the Commissioner of Patents in regard to the application of Camille A. Faure, filed May 25, 1887, for alleged new and useful improvements in the application of secondary batteries as a motive power. In the specification the invention was stated to consist "in the application of secondary batteries or accumulators preferably carried by a vehicle or upon one of a train of vehicles to supply electrical energy to one or more electro-magnetic motors also carried by or upon said vehicle, or one or more of a train of vehicles, combined with means for varying the amount of energy supplied by the battery." It will be remembered that the decision of the Commissioner of Patents, which was given Feb. 21, of this year, held that the combination was not new, and was therefore not patentable, and ascribed the commercial success of the alleged invention to the Faure battery alone, and not to the combination. In the present decision the court says:

"It is made evident that the mechanical arrangements for applying the power are not new, being familiar to all experts; and that the result is not new, viz.: the movement of vehicles by electrical storage batteries. It is admitted that Trouvé had propelled boats in this way. The contention that such a use did not anticipate this application because that experiment was on water and this invention is designed for use on land seems untenable. The propulsion of vessels through water by such batteries is within the same principle as locomotion on land. It has been decided that the application to a paddle-wheel vessel of a device borrowed from a land vehicle, or from a windmill, is not patentable. . . . We think it would be doing a wrong to previous patentees and to the public generally if we should hamper the success of the very important problem of electric locomotion now attracting public attention everywhere, by assisting in the grant of the patent applied for.

"The subject of a patent, in the absence of a specific grant of the Government, belongs to the public as common property. In proper cases a monopoly is granted to the inventor, and during its continuance it will be protected. Faure has already obtained a prolonged monopoly for his valuable improvement in secondary batteries. If they are the best obtainable the public will be forced to use them, and their use will remunerate him for his labor. But this furnishes no reason why 17 years in addition should practically be given to his patent by the grant of the very broad claim to use this device. The decision of the Commissioner is affirmed."

While this decision, upholding the action of the Patent Commissioner, was entirely to be expected, it seems unfortunate that the opinion accompanying it is not more strongly intrenched in legal lore. As to this we speak at more length in our editorial columns.

The Zigang Polyphone.

It is well known, writes M. Ed. Hospitalier, in *La Nature*, that the vibrating plate of a telephone may be made, under the influence of undulatory electric currents, with the necessary graduations and modulations, to reproduce all the sounds and the tones the most diverse in a gamut of the most extended scale, with only the slight and almost imperceptible alteration which is due to the fundamental sound of the vibrating plate itself. This will not be the case if we make use of the plate to modulate the current. We have already had occasion to describe M. Zigang's electric trumpet, in which a current being periodically interrupted by the vibration of the plate produces a continuous sound of peculiar tone. This electric trumpet constitutes an apparatus midway between the telephone and the electric bell, for which latter it may be substituted with advantage in a great number of cases. The first of M. Zigang's trumpets were somewhat disagreeable in sound, and the pitch was often ill defined. By rearranging the whole system with entirely metallic fittings, by suitably modifying the thickness of the plate, its diameter, peripheric mounting, the armature mass, the capacity of the resonator, and the proportions of the electro-magnet, the sound was perceptibly improved. It acquired a tone approaching to that of the hautboy, one which could be modified to considerable extent by a well arranged combination of the various organs contributing to its production. But M. Zigang aimed at something more. He aimed at transforming the monophonic trumpet, which was only capable of a single, with a perceptibly uniform pitch, into a polyphone, or a single apparatus capable of emitting several well defined notes. He succeeded in this by turning to advantage the connection existing between the pitch of the principal sound furnished by the vibrating plate and the diameter of the latter. The following figures illustrate the principal dispositions of the apparatus, as well as the mode of putting them in action.

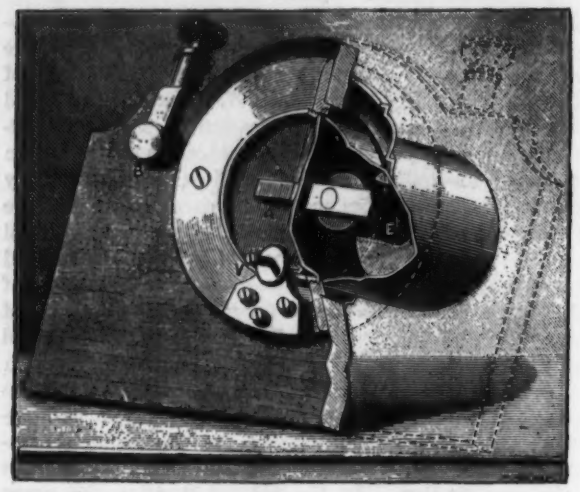


Fig. 1.—Zigang Polyphone.

The polyphone is no more than the original trumpet formed out of an electro-magnet (Fig. 1) mounted in front of a vibrating plate, to which a soft iron armature, *A*, is attached. A platinum contact, *V*, closes the circuit of a battery upon the electro-magnet, and breaks it as soon as the plate is attracted, in order to establish it anew when the plate has recovered its initial position, and so on. The sound which is thus emitted is that corresponding to the natural vibration of the plate under the influence of the periodical creation and suppression of the currents traversing the electro-magnet. But by applying a blunt point to the plate we immobilise the entire portion of it comprised betwixt the periphery of the plate, which is fitted to the mounting, and the concentric circle which passes through the point touched. The plate thereupon emits an acute sound, which is the more acute as the point touched is nearer the center. By touching different parts of the plate it may be made to emit different sounds with a certain correspondence between the tones and half-tones of the chromatic scales; so that it is possible to obtain real music. This M. Zigang actually did, although the entire extent of the instrument was no greater than an octave. Each note is struck by pressing a contact button, *B*, (Fig. 1), with the left hand, whilst with the right we manœuvre the blunt point upon the surface of the plate. The connected movements are particularly facilitated by means of this instrument, upon which the inventor has already played several pieces arranged for it and for the piano. It would be possible to add to the apparatus special dispositions allowing of the easy realization of the *forte* and *piano* notes. This might be done by introducing variable resistances into the circuit, either by varying the number of the elements by means of a commutator or by introducing into the circuit, an iron-cored coil so as to modify the circuit's coefficient of self-induction and thus enfeeble or enhance the intensity of the sounds at will. But it must not be lost sight of that the pitch of each fundamental sound is a function as well of the electric source and the interpolated resistances; so that the position of the contact corresponding to a note of given pitch is not always the same, but varies with the intensity of the sound obtainable, and which fact renders the performance somewhat complicated.

Fig. 2.—Operating the Polyphone.

Nevertheless, M. Zigang's polyphone is an original and diverting instrument, and it has appeared to us worthy of being presented to our readers, if only because of its simplicity and of the experiments which it enables us to make for the purpose of imparting and demonstrating not a few of the principles of musical acoustics.

Common Sense from Brooklyn.

It is positively refreshing to find one of our daily contemporaries taking so thoroughly sensible a view of the electric railway question as is expressed in the following editorial remarks of the Brooklyn *Eagle*:

"The whole question turns on the comparative safety or the comparative danger of the overhead wire system. That question is one of facts and nothing else. It will not, of course, escape gossip, exaggeration, apprehension, sensational reporting and lurid treatment of every kind. Such treatment is inevitable. The locomotive received it, when it was first put in use. The first years of every horse car company in every city have always experienced such treatment. People will talk a great deal about things which they know nothing of, and the less they know of it the more they will talk about it. The locomotive and the horse car, however, were finally settled by knowledge and not by ignorance, by examination and not by clamor, by facts and not by sensationalism. So will the question of the introduction or non-introduction of the overhead wire system. Fortunately, that system is sufficiently in use for persons to learn whether it is desirable or undesirable in Brooklyn. Albany was the latest city to get it, and its introduction was there strenuously fought. The wide streets of that town are peculiarly favorable to its use, and since they have got and have tried it the people there say that they would not part with it for anything and wonder that they were fools for so long a time as to do without it and oppose its incoming. Washington has it, and the avenues there are broad and open. It is extremely popular in that city.

"The system is used extensively in Boston, and its use there has been made the subject of any amount of outside discussion. Bostonians, so far as the *Eagle* can find out, like it remarkably well. Accounts of the dangers and of the accidents to which the system, as used in Boston, is liable, accounts as long as a man's arm and as sensational as a 'base-ball extra,' have not been wanting in many newspapers, and those accounts are excitable and stimulating in proportion to the distance of the papers set on fire by them from Boston. Minute examination, however, indicates that a great deal more is said about the liability to accidents of a serious kind there than about accidents of that sort really happening. There was an account in yesterday's papers of an accident there by which two horses were killed, and a great many people were 'excited,' but so long as none of the excited people themselves were hurt, universal sympathy for the deceased nags can hardly be expected to have more than a brief duration."

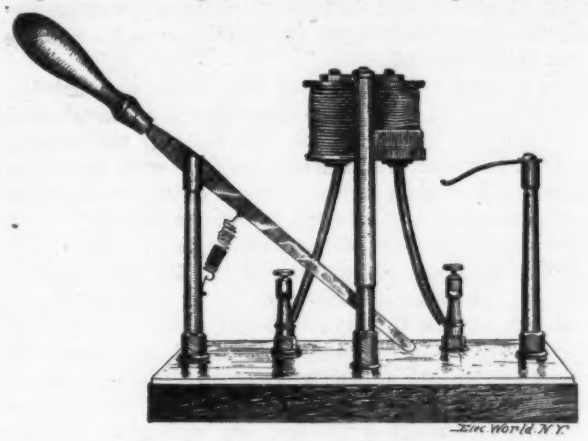
We may add that there are few electricians in the electric railway service who have not received one or more shocks with the full potential of the line. In spite of this there is not yet recorded a single fatal accident. The only one reported was investigated by The Electrical World last winter, and shown to be due to another cause, the alleged victim not having even received a shock.

Electrical Exhibition on the Pacific Slope.

Arrangements are being made for a large display of electrical apparatus in the North-west Industrial Exposition to be opened at Spokane Falls on the 1st of October. This Exposition promises to be a great center of attraction to residents of the Pacific North-west, and will embrace exhibits from Washington, Oregon, Idaho and Montana. The Electrical Society of Spokane Falls has taken in hand the electrical exhibit department, and has secured a large space for this purpose. One prominent electrical house has volunteered to light up the Exposition and supply power to run the machinery. This is to be done by 200 h. p. electric generators, power being derived from the water falls of the Spokane River, about a mile from the building. Other firms are coming forward with offers to place exhibits in the Exposition, considering it to be one of the best methods of advertising electrical apparatus. There is probably no section of the world where the electrical industries are making such rapid advancement as in the far West, and this exhibit will be eagerly examined by men of influence and capital who have electrical interests in the various sections from which they come.

A Useful Safety Cut-out.

The accompanying cut shows a safety cut-out for dynamos. It is taken from a photograph of one of a pair of similar instruments which have been used—on a couple of Weston dynamos in New Haven—for some three years past. The arrangement is simple enough. The two outside posts were in series with the shunt coils and the field magnets. When the lever was pressed in contact with the spring, the dynamo started into action and held the lever in position so long as the circuit was complete; but, of course, if for any cause the circuit was broken the machine would be instantly thrown out of action and remain harmless until such time as the lever was again raised. The instrument shown was installed by Mr. J. F. Denison, and has been in steady service.

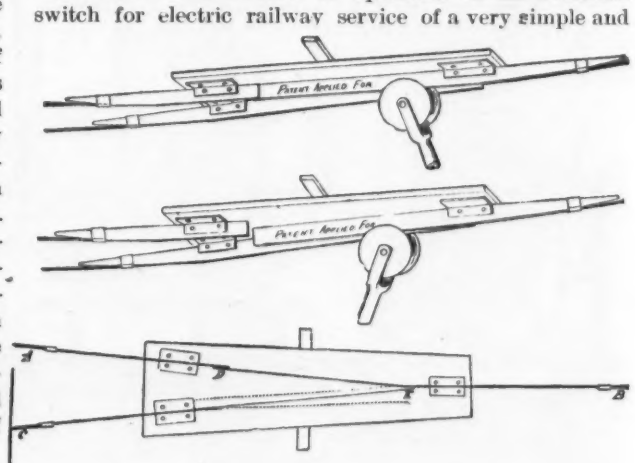


Safety Cut-out for Dynamos.

The protective principle involved is really a very serviceable one and might be advantageously employed on very many arc circuits. The object of such a contrivance is to prevent accidents happening from broken lines; if, for example, a line wire snaps and grounds itself or falls across another conductor, the result is an enormous rush of current which in many cases may destroy the dynamo or produce serious results by crossing with some innocent wire leading to a distant point. If such an accident happens where the safety cut-out is used, the dynamo will be cut out before the fallen end of the wire can strike the ground or cross another wire, avoiding all danger of damage to the machine or of accident through fire or shocks.

An Overhead Electric Railway Switch.

The accompanying illustrations show very clearly the construction and method of operation of an overhead switch for electric railway service of a very simple and practical design, which the Illinois Electric Material Company, of Chicago, has placed upon the market.



Figs. 1, 2 and 3.—Electric Railway Switch.

In Fig. 3 is given a view of the plan of the switch; *A-B* and *C-B* represent the two tracks. In Fig. 1 the car is traveling along the track *A-B*. When the trolley wheel reaches the point *E*, it opens a space wide enough to allow the trolley wheel to pass. After the wheel has passed, the fin springs back into its original position. When the car is traveling on track *B-C*, as shown in Fig. 2, the fin *E-D* is passed over to *E-C*, allowing the trolley-wheel to pass along the track *B-C*.

Practical experience has demonstrated that it is impossible for the trolley wheel to jump the track, no matter at what speed the car may be running. The base on which the fins are placed is galvanized sheet iron, and the fins, or more properly, the switches, are made of the best saw blade steel.

The trolley wires are fastened by clamps to the ends of the switches, and do not need to be soldered. The whole arrangement is supported by guy wires fastened to lugs extending at right angles to the switch, as shown in Fig. 3.

The Working Efficiency of Secondary Cells.*

BY W. E. AYRTON; C. G. LAMB, F. W. SMITH, and M. W. WOODS, Associates.

I.—PREVIOUS TESTS OF CELLS.

Since 1881, when the formation of Planté storage cells was greatly accelerated by Faure's device of pasting the plates, numerous tests have been made in different parts of the world on the capacity and efficiency of secondary cells. The first tests that were carried out were conducted simultaneously, at the end of 1881, in England by Professor Perry, with one of the authors of this paper, and in France by a committee consisting of Messieurs Tresca, Potier,

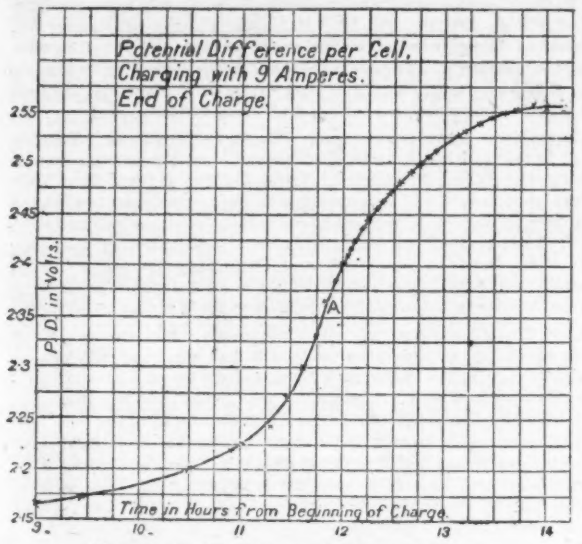


FIG. 1.—P. D. CURVE—END OF CHARGE.

Joubert and Allard, working at the Conservatoire des Arts et Metiers, with a staff of assistants.

In the report—communicated to the Physical Society in February, 1882—by the two English experimenters, it was pointed out that the great "resuscitating power" of the cells made it very difficult to say when they were entirely discharged, and therefore, in order to test the efficiency, the cells were first "emptied" of charge by discharging them until the discharge current was very small, and finally leaving them short-circuited for many hours with a short bit of thick wire. Next, a measured amount of energy was put into these "empty" cells, and they were then thoroughly discharged on three successive days, being insulated and allowed to recuperate during the two intervening nights. Although the energy efficiency thus obtained, and which was not less than 82 per cent., probably represented much more than could be obtained in practice at that period, if the discharge were stopped before the E.M.F. fell to so low a value, this efficiency represented something quite definite, since all the energy given out by the cells in the discharge must have been put into them during the measured charge, no demand being made on some unexhausted store of energy previously put into the cells.

The French committee, on the other hand, considered the cells as being discharged when a certain current which was originally produced through a fixed resistance

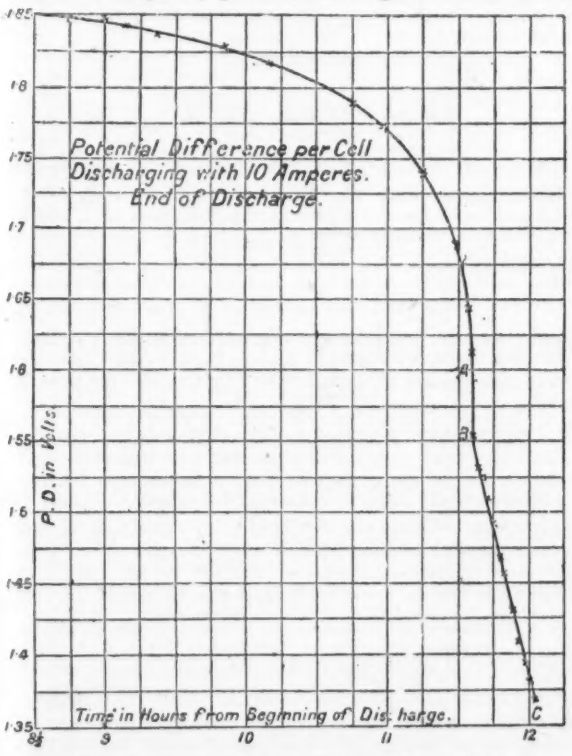


FIG. 2.—P. D. CURVE—END OF DISCHARGE.

by 30 cells could no longer be kept up, even when the number of cells had been increased to 35. But unless, subsequently to the receipt of the cells from the manufacturers, they had been charged and discharged several times until the same cycles of values of E. M. F. with time were repeated with each charge and discharge, there was no guarantee that in the experimental discharge the cells were not drawing on a store of energy put into them before leaving the manufacturers' premises, and thus giving a higher value than the "working efficiency."

And we are afraid that a very possible neglect of the powerful resuscitating power of accumulators may have vitiated some of the published results of experiments that have been made on them. This doubt must not be forgotten in considering the accompanying list, which is as complete as we have been able to make it, of all such experiments that have been made up to date. At the middle of 1889, when we had nearly completed our investigation, there appeared two very important contributions to the subject—one on "The Inherent Defects of Secondary Batteries," by Dr. Louis Duncan and H. Wiegand; the other, "Ergebnisse von Versuchen an Akkumulatoren fur Stationsbetrieb," by Prof. W. Kohlrausch and C. Heim. These investigations are extremely interesting, as they confirm some of the results which we had also arrived at, and to which reference will be made in this paper; Prof. W. Kohlrausch and C. Heim, for example, laying great stress on the fact that the discharge of an accumulator does not depend merely on the previous charge, but on the previous history of the cell.

At the Central Institution there are three distinct types of E. P. S. cells in daily use. The cells, however, used by us for the investigation were 20 out of a group of 50 of what is known as the 1888 type. This type we selected since it was the latest constructed by the Electrical Power Storage Company. The particular specimens of this 1888 type, which are at the Central Institution, contain each two positive and three negative plates, each plate, exclusive of the lugs, being 9¼ by 9¼ inches. The glass vessels containing these plates are large enough to each hold 7L plates, but we preferred to use 7L glass boxes to having smaller boxes specially constructed.

The total weight of each of these cells is about 59 pounds 12 ounces, made up as follows:

	Lbs.	Oz.
Three negative plates	About 17	2
Two positive "	" 11	8
Ebonite strips	" 0	8
One glass vessel	" 7	8
Dilute sulphuric acid	" 23	2

and the cells are intended to be used with a maximum current of 9 ampères on charging and 10 on discharging.

The first point to settle with reference to the discharge was whether the resistance in the circuit should be kept constant, or whether, as the E. M. F. fell, the resistance should be varied in such a way as to keep the current constant. This latter method, although it involved much more labor, was adopted. At first the current was kept constant by varying the resistance by hand as the E. M. F. of the cells altered. But this required the constant presence of one of the observers day and night, partly to vary the resistance from time to time, and partly to start the charging directly the discharging was finished, in order that the cells might never be left discharged. Hence an automatic arrangement, which will be described later on, was subsequently devised, and by means of it the current was maintained more constant than could be achieved by even very careful hand regulation, and the circuit broken during discharging and during charging the moment the P. D. reached certain prearranged values.

We had next to adopt a criterion by which to settle when a charge or discharge could be said to be completed. Such a criterion may be made to depend on a variety of changes that take place in a cell, three of which are in common use—viz., change in the specific gravity, gassing, and change in the P. D. In the case of the cells tested by us, and which have more liquid in proportion to the plates than is usually the case, the change in specific gravity from charge to discharge is from 1.2 to about 1.17; and, as our experiments show that the change is directly proportional to the time when the current is kept constant, the change in the specific gravity per hour is only about 0.002, which is far too small to be read very accurately with ordinary hydrometers. But it is known the fall in the E. M. F. of the cells at the end of the discharge is very rapid, so that half an hour more or less in the time of discharge produces a great difference in the value of the E. M. F.; hence it follows that, if a specific gravity test were alone employed with our cells as a criterion of charge and discharge, it would be necessary to read the specific gravity accurately to less than 0.001 at the end of the discharge. The amount of gassing is also far too rough a test, and cannot be employed at all in the discharge, hence we were led to resort to the variation in the P. D.

A number of experiments were now made on two of the cells in order that the *exact* shape of the curves of P. D. at the *end* of the charge and discharge might be ascertained. The curve shown in Fig. 1 is the end of the P. D. curve for

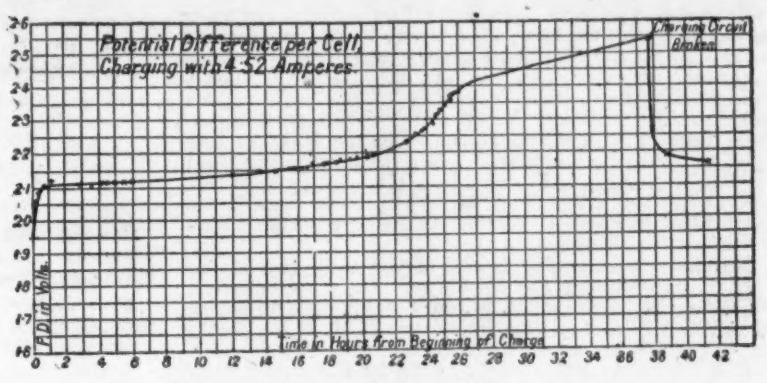

Potential Difference per Cell,
Charging with 4.52 Amperes.
Charging Circuit Broken
P.D. in Volts.
Time in Hours from Beginning of Charge.

FIG. 3.—P. D. CURVE—CHARGING WITH 4.52 AMPERES.

one cell on charging with 9 ampères for 14 hours; from which we see that the rate of variation of the P. D. with time is greatest when the P. D. is about 2.36 volts, indicated by the point *A*. In Fig. 2 is shown the curve of P. D, during the last 3½ hours of a discharge with 10 ampères, the discharge being continued for 12 hours. In this particular experiment the discharge was allowed to continue until the P. D. fell to 1.365 volts, indicated by the point *C*, which is far lower than we have dared on any other occasion to allow the P.D. to fall. At about 1.8 volts the P.D. curve begins to fall pretty rapidly, and the slope of the curve, or the rate of diminution of the P. D. with time, goes on increasing until the P. D. has fallen to 1.6 volts, indicated by the point *A* on the curve in Fig. 2. Here $\frac{dV}{dt}$ per cell has reached a value of 1.4, *V* being measured in volts and *t* in hours. Below this the curve has a shape that has not hitherto been noticed, for when the P. D. per cell has reached 1.556 volts, indicated by the point *B*, the curve

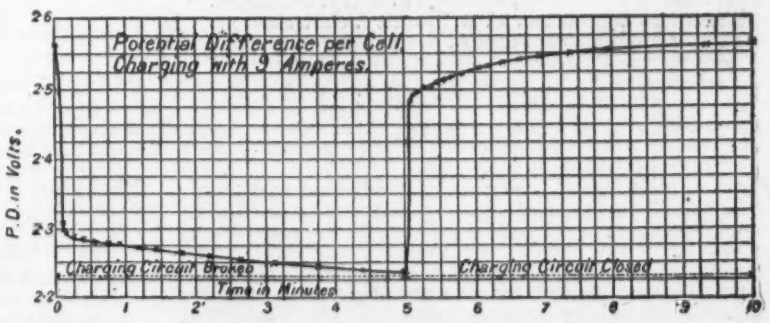


FIG. 4.—P. D. CURVE—CHARGING WITH 9 AMPERES.

suddenly alters its shape, becoming the straight line *B C*, with a less inclination to the axis of time, $\frac{dV}{dt}$ being for this line only 0.44.

Just as we have in the curve in Fig. 2 continued the discharge much below the usual limit, so we examined what would take place if the charging was also prolonged much beyond the usual limit. Curve 3 shows the rise of the P. D. when the charging at 4.52 ampères was continued for 37½ hours, 25½ hours being sufficient to fully charge the cells with this constant current of 4.52 ampères; that is, to charge them until the P. D. per cell was 2.4 volts. It will be observed that whereas the volts rise from 2.25 to 2.38

EFFICIENCY TESTS OF ACCUMULATORS.

Date.	Maker of cell.	Experimenters.	Efficiency. Quantity.	Efficiency. Energy.	REMARKS.
1882	Faure	Ayrton and Perry		82	Cells short-circuited for some time before being tested. Cells discharged on three successive days, and allowed to recuperate during the two intervening nights.
1882	"	French Commission	92	70	Result of a week's work. Current kept fairly constant during discharge by the addition from time to time of fresh cells.
1883	Schultz	Hallwachs		6 to 50	Results variable and indefinite.
1883	E. P. S.	H. Morton	90		
1883	"	Aron		6 to 50	Results very variable.
1885	B. T. K.	Forbes	80	69	Mean of one week's work. Current not kept constant.
1886	Farbaky and Schenek	Waltenhofen	91.7	78.7	
1886	E. P. S.	Drake and Gorham	90	80	Current maintained constant during charge and during discharge.
1887	"	Haeberlin	92		"Cells not good."
1887	Fitzgerald	Lea	91		
1887	"	Huber		88	
1887	C. Smith	Miller	80		Lead spirals painted over with salts.
1888	Huber	W. Kohlrausch	90.7	78.4	
1889	Farbaky and Schenek	Waltenhofen	88.1	77.4	
*1889	Tudor	W. Kohlrausch & Heim.	94	82.4	Normal currents used in charging and in discharging.
	"	" "	77	64.7	Charging and discharging currents rather more than twice the normal.
	"	" "	81.4	71.7	Cells allowed to rest for 160 hours after charging.
	"	" "	90	80	Cells first completely discharged by the external resistance being gradually diminished to nought.

*The positive plates of these Tudor cells are first formed by Planté's process, then the holes in the girds are filled with minium, and the forming continued. The negative grids are not formed at all, but merely have the holes in the grids filled with lead oxide.

* Paper read at the extraordinary general meeting of the Institution of Electrical Engineers, at Edinburgh, Scotland, July 16, 1890.

between 23.1 and 25.5 hours—that is, 0.13 volt per cell in 2.4 hours—the rise in the following 12.3 hours is only from 2.38 to 2.55 volts; this is only 0.17 volt. The continuation of the curve shows the drop of P. D. on breaking the charging circuit: there is an instantaneous fall of 0.28 volt per cell, and a further fall of 0.1 volt in the E. M. F. in two hours.

The curve on Fig. 4 shows on a larger scale this drop on breaking the charging circuit when the cells are very well charged, leaving it broken for five minutes, and then closing it again; the charging current in this experiment being 9 ampères. There is, we see, a nearly instantaneous drop of the terminal P. D. per cell from 2.56 to 2.31, then a steady fall in the E. M. F. from 2.31 to 2.24 volts in five minutes. On reclosing the charging circuit at this moment there is an instantaneous rise of the P. D. to 2.48 volts, and then a slow rise to 2.56 volts in five minutes; so that after reclosing the charging circuit it took, in this experiment, the same time for the P. D. to recover the value it had just before breaking as the time during which the circuit remained broken.

Experiments were also made on the time rise of the E. M. F. on stopping the discharge. Later on, however, the time rise of the E. M. F., on breaking the discharge circuit, as well as the time fall of the E. M. F., on breaking the charging circuit for various currents, was measured in a far more sensitive way than in the early part of this investigation. This subject will, therefore, be left until further on in this paper.

On starting a discharge the P. D. generally falls slightly to the value that is maintained fairly constant during a long portion of a discharge. After a prolonged rest, however, we have found that the P. D. on the contrary, shows a *decided rise* at the commencement of a discharge, and that it is not until the third discharge takes place that the curve resumes its normal character with the slight drop in the value of the P. D. at the commencement of the discharge.

(*To be continued.*)

Programme of the Twelfth Convention of the National Electric Light Association.

The Committee on Papers has selected the following topics and has invited the persons named to prepare a paper, or open the discussion on the subject assigned them:

1. Electrical Industries and the World's Columbian Fair. J. P. Barrett, Chicago.
2. Electric Light as Supplied to Steam Railroads. W. H. Markland, Altoona, Pa.
3. Standards of Economy in the Generation of Power and Steam Under Best Conditions. Editors of *Power-Steam*, New York.
4. Triple Expansion High Speed Engines for Central Station Work. Ed. F. Williams, Beloit, Wis.
5. The Model Boiler Room and the Duties of a Fireman. Jarvis B. Edson, New York.
6. Ferranti Station, London, England. Caryl Haskings, Lynn, Mass.
7. The Proper Care and Management of Alternating Currents. T. Carpenter Smith, Philadelphia.
8. Distribution of Energy by Alternating Currents and Transformers and the Proper Method of Proportioning Conductors. A. L. Rohrer, Lynn, Mass.
9. The Proper Basis for Determining Electric Motor Rates. H. L. Lufkin, New York.
10. Actual Cost of Furnishing Arc Lighting (1,200 c. p. and 2,000 c. p. lamps) under the Best Possible Conditions. J. C. Ayer, St. Louis.
11. Municipal Ownership of Electric Lighting Plants. M. J. Francisco, Rutland, Vt.
12. Accidents in Electric Lighting Stations and Plants. Prof. Chas. R. Cross, Boston.
13. Care and Labor in Electric Light Stations and its Value. A. J. DeCamp, Philadelphia.
14. How can the National Electric Light Association best Serve the Interests of Central Station Companies? C. R. Huntley, Buffalo, N. Y.

The reports to be considered are as follows:

1. Committee on National Insurance Rules; George Cutter, chairman.
2. Committee on Electrical Data; A. J. DeCamp, chairman.
3. Committee on Copper Tariff; Charles A. Brown, chairman.
4. Committee on Underground Conduits and Conductors; Joseph E. Lockwood, chairman.
5. Committee on Revision of Constitution; M. J. Francisco, chairman.
6. National Committee on Legislation; Allen R. Foote, chairman.
7. Committee on Relations between Manufacturing and Central Station Companies; Marsden J. Perry, chairman.
8. Executive Committee; C. R. Huntley, chairman.
9. Finance Committee; John A. Seely, chairman.
10. Secretary and Treasurer's Report; Allen R. Foote.

At each session of the convention a call will be made for the proposal of questions to be discussed at a subsequent session, and for the introduction of resolutions to be considered at a subsequent session when reported by the Committee on Resolutions for action.

Members desiring to take part in the discussion of any subject stated or proposed, who send their names to the secretary previous to the time appointed for the consideration, will be called upon by the president and given time before the subject is opened to the convention. By this means every member can secure recognition and time to express his views fully on any subject that may come before the convention It is not expected that those who read papers or open the discussions will monopolize all the time that can be given to any particular subject. The best results from discussions can be obtained only when every member who has an idea to explain, a suggestion to offer, or a bit of experience to relate regarding any subject before the convention, will avail himself of the regulation stated above, to secure recognition and time that will give him an opportunity to make his contribution to the common stock of information.

An announcement of an order of proceedings will be made for each day on the preceding day. The subjects and reports will be taken up in the order there named, and will be held under consideration until finished. Each afternoon session will be prolonged until the calendar for that day has been cleared.

The last session will be an executive one to be attended by active members only. The business to be brought before this session will be:

1. Secretary and Treasurer's report.
2. Report of Finance Committee.
3. Report of Executive Committee.
4. Action on report of Committee on Revision of Constitution.
5. Election of Executive Committee.
6. Selection of next place of meeting.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, Aug. 4, 1890.

Electric Light Bids.—Bids for 627 arc lamps at 35 cents each per night have been accepted by the Gas Commission for lighting the streets of New York city.

Dividend.—The Automatic Fire Alarm and Extinguisher Company, Limited, 413 Broadway, this city, has declared a two per cent dividend, payable in cash Aug. 15, to stockholders of record Aug. 5.

A handsomely illustrated catalogue of screw glass insulators has been issued by Wm. Brookfield, New York. It contains 11 full page cuts of glass insulators manufactured by Mr. Brookfield.

St. Johnland, N. Y.—A conduit for electric wires is to be introduced into the buildings at the St. Johnland County Farm. The plans have been approved by the Commissioners of Charities and Correction.

Mr. Geo. W. Walker, of the Walker Electric Company, this city, will start for Europe on the 14th inst. to exhibit his meter in England and France, and to enter it for competition at the meter contest in France.

The New York Electrical Device Company has been incorporated at Alexandria, Va., with J. M. Glover, of St. Louis, Mo., as president, and C. W. Field, Jr., of New York city, secretary. The capital stock is $500,000.

On the Fourth avenue line, in this city, the United Electric Traction Company now has five storage battery cars in daily service, and more will be added as soon as they can be fitted up. Two similar cars have been put in service in Indianapolis, Ind.

Brooklyn's Electric Lights.—It is said that the Citizen's Electric Light Company, which has formerly supplied only arc lights, is about to enter the field of incandescent lighting with the Westinghouse alternating system as a competitor of the Edison company.

Newark, N. J.—An unoccupied building owned by the Newark Electric Light and Power Company, and partially occupied as a storeroom for the construction material of the Newark Passenger Railway Company was recently damaged by fire to the extent of about $700.

Mr. Edison's New Company.—The object of the new organization known as the Edison Industrial Works, in which Mr. Edison is very largely interested, is to manufacture, buy, sell, lease and use machinery and apparatus for mechanical, scientific, mining and chemical purposes, to manufacture inventions, and to purchase mines, factories or other property. The company will have offices in New York, Pennsylvania and other states.

The Trolley System for Brooklyn, N. Y.—The three Brooklyn surface railroad companies which control most of the street car lines in Brooklyn have decided to adopt electricity as a motive power, using the overhead system of wires. They are the Brooklyn City Railroad Company, Deacon Richardson's Atlantic Avenue Company and Gen. Slocum's Jay and Smith Street Company. Gen. Slocum visited Albany on Monday of last week by appointment to advocate before the Railroad Commissioners the extension citywards of the electric system that operates his Coney Island road. The applications of all the lines for permission to use electricity are now before the Common Council, and the consent of property owners along the various lines is being solicited.

A Field for the Steam Heating Company.—A correspondent of the New York *Times* suggests a possible field of usefulness for the Steam Heating Company of this city. He says: "I see in the papers that there is great opposition to the steam heating company of your city, and that it is supposed to be a nuisance to health and an injury to property. I would like to propose an idea. There being a large reward offered in Anstralia to any one that can clean out the rabbits, I think the Steam Heating Company would find a business to their advantage by transporting their heating utensils, and relieve by steaming the burrows of those infernal pests. The work could be done by piping the surface and using portable engines. I think there is money in this." W. T. H.

NEW ENGLAND NOTES.

Branch Office of the Electrical World,
Room 8, Cook Building, cor. Franklin and Congress Sts.
Boston, Aug. 2, 1890.

A new dynamo will be added to the electric light plant at Windsor Locks, Conn., having a capacity for 750 lights.

The Sprague motors are used in Boston to operate a bread mixer, and with this combination bakers are able to accomplish in four or five minutes an amount of work that otherwise requires hours of hand labor.

Accident.—The Edison Electric Illuminating Company, of this city, sustained a small loss last Sunday evening in the blowing out of the cylinder head of one of the engines used for driving West End Railway power dynamos.

Mr. J. W. Moore, superintendent of the Allston division of the West End Railway, has been transferred to the superintendency of the first division. Mr. Moore's promotion is due to his long experience on the electric lines of the West End Company.

Mr. Harry Baum, vice-president of the Fidelity Carbon Company of St. Louis, favored Boston with his presence Tuesday of this week. Mr. Baum reports business as good, and says that the favorite Boston bean still has a large share of his affection.

Rutland, Vt.—The Marble City Electric Light Company, of Rutland, Vt., has been reorganized as the Marble City Electric Light and Power Company, with a capital stock of $25,000. When half this amount is subscribed the plant is to be immediately increased.

Electric Fans.—This warm weather brings the Woonsocket (R. I.) Electric Machine and Power Company all the orders it can comfortably take care of for electric fans and accessories. This shows that the people there are beginning to recognize the electric motor as their friend in hot weather.

Lighting Contract Signed.—Mayor Peck, of New Haven, Conn., has signed the city's new contract with the electric light company. By the terms of this contract the city is to be illuminated by 225 lamps at 36 cents per night for each lamp, with the privilege of increasing the number of lamps to 300 at a rate of 36 cents per night for each lamp.

Appeal Sustained.—The Massachusetts Board of State Gas and Electric Light Commissioners has sustained the appeal of the Chelsea Gas and Electric Light Company against the granting of the permit by the board of aldermen, to the American Fuel Company, to open the streets of that city for the purpose of supplying gas for heating and lighting purposes, and has ordered the decision of the board of aldermen to be reversed.

The European Electric Welding Company will, according to the Boston News Bureau, receive immediately from the English syndicate £20,000. The City of London Contract Company will guarantee the payment of the remaining £40,000 on Nov. 1, as will, also, the delivery of the shares of the English company to the extent of 33⅓ per cent. The new contracts now await signatures, but there seems to be no doubt of final completion.

Cape May Announcement.—There has been no reduction made in railroad fare between Boston and New York to persons attending the National Electric Light Convention at Cape May, Aug. 19, 20 and 21, and it will be necessary for 25 persons to go and return in a body to secure 15 per cent. reduction by either rail or Sound lines. Fifty persons and over could secure a further corresponding reduction. Between New York and Cape May the Pennsylvania Railroad will furnish round trip tickets good for ten days at $5.25. These tickets can be procured in Boston at 205 Washington street.

The Tropical American Telephone Company, of 95 Milk street, this city, informs me that it has acquired the sole interest in the Hynes annunciator drop, better known as the Williams switchboard drop. The patent, which has been pending since 1882, was granted last April. It covers all the drops in the Williams switchboards, and the company is confident that it is destined to be quite an important factor in the company's financial affairs. This company reports that it is now manufacturing its own switchboards, and that it will exact a royalty from others for the further use of these drops.

Supervision of Electric Wires.—Mayor Hart has sent to the board of aldermen of this city the draft of an ordinance for the regulation and control of electric wires in Boston. The proposed ordinance has six sections. It provides for the creation of a department of electric wires, to be under the charge of a superintendent, to be appointed by the mayor and confirmed by the aldermen, for a term of three years from May 1, his salary to be $4,000 a year. The superintendent shall have supervision and regulation of all electric wires, including telegraph, telephone, light, power and other wires incidental thereto, whether under or over the streets and buildings throughout the city, and shall make and enforce reasonable rules and regulations for the construction, maintenance, attention and removal of all dynamos, electric machines and appliances, and all electric and other wires. No application for the erection of electric machinery or wires or of poles, conduits and other appliances incidental thereto, shall be deemed complete unless approved by the superintendent of electric wires. He shall prepare and continue from day to day a list of all electric light and high-pressure wires, and of all machinery set up for the production or use of high electric pressure throughout the city. High power or pressure is defined to mean an electromotive of 500 volts or more. This superintendent is to have the control and management of the fire alarm of the city of Boston and of the public bells and clocks. He shall render such services to the fire department as the fire commissioners may require, provided such services are directly connected with the fire alarm or with the necessary protection of buildings from fire caused by electric appliances. Sec. 6 provides for printed reports to be made to the mayor in April, June and October for the preceding three months, and in January for the preceding calender year. This was referred to the committee on ordinances. L. H. H.

PHILADELPHIA NOTES.

Branch Office of the Electrical World,
31 City Building, Philadelphia, Aug. 2, 1890.

Hollidaysburg, Pa.—The Wheeler Reflector Company of Philadelphia has contracted to furnish this village with 67 street lamps fitted with its patent reflectors.

Union Hill, N. J.—The Complete Electric Construction Company has contracted with the Keystone Engine Works of Philadelphia for an 80 h. p. Buckeye engine and a 120 h. p. boiler.

Messrs. Booth, Garrett & Blair have in operation at their new chemical laboratory a 50-light storage battery plant, operated by an Otto gas engine, all installed by the Quaker City Electric Company.

The Julien Battery.—The Consolidated Electric Storage Company, manufacturers of the Julien storage batteries, reports its sales during the month of July as nearly double that of any month since these cells have been placed on the market.

Installation of Engines.—The Building Committee of the Drexel Institute has directed Messrs. M. R. Muckle, Jr. & Co., to install three Westinghouse compound engines, cylinders 10 and 18 × 10, instead of Westinghouse standard as first determined.

A New Plant.—The Quaker City Electric Company has installed a 400 incandescent and 40 arc light plant for Messrs. Alexander, Crow & Son, proprietors of the Caledonian Carpet Mills of this city. All will be driven by a 90-h. p. Beck automatic engine.

Lighting Contract Awarded.—The contract for lighting the almshouse at Philadelphia has been awarded to the Fort Wayne Electric Company for $4,452. The plant will comprise 30 Wood arc lights with a Wood dynamo and an Armington & Sims engine.

The Lehigh Passenger Railroad Company is now having a second 100-h. p. boiler and a 13 and 22 × 13 inch Westinghouse compound engine installed by Messrs. M. R. Muckle, Jr. & Co.; also a 60,000 watt dynamo by the Electro Dynamic Company. The company has so far only received the batteries for four cars and is carrying from 50 to 110 passengers on each car each trip.

The Thomson-Houston Motor Company has recently installed the following motors in this city: Two 15 h. p. for the Pennsylvania Railroad Company; one 2 h. p. for the Electro-tint Engraving Company; one 2 h. p. for the Church of the Holy Communion, one 2 h. p. for Wm. B. Graham, paper box manufacturer, one 3 h. p. at the *Germantown Independent* office, and one 2 h. p. for Messrs. Marshall E. Smith & Bro., for running sewing machines.

Messrs. Walker & Kepler have just installed a 350-light plant for the Martin & W. H. Nixon Paper Company, of Manayunk, Pa., the largest paper mills in this part of the country, their works covering over ten acres. Walker & Kepler report an increase of over 500 per cent. in their business during the month of July as compared with July of 1889. They have over 20 plants in course

construction, one of them being a 2,300-light plant in one of our largest mills.

The Reading Railroad Company's New Plant.—The alternating arc plant installed by M. R. Muckle, Jr.. & Co., for the Reading Railroad Company at Port Richmond was started last week, and the railroad company has now discontinued all the rented lamps formerly used and is dependent on its own plant. The plant consists of a 60 h. p. return tubular boiler, a 45 h. p. standard Westinghouse engine and a 60-light alternating arc machine, with 50 lamps. The company has ordered lamps to the full capacity of this machine. W. F. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, August 2 1890.

The Jenney Electric Motor Company, of Indianapolis, Ind., is sending out a very handsome card containing an illustration of the Jenney motor.

The City Electric Railway Company, at Owosso, Mich., has been organized with a capital of $50,000. The incorporators are G. W. Cochran, C. S. Becker and B. Franklin.

The Pond Engineering Company, of St. Louis, Mo., in order to handle its business to better advantage, has opened an office at Dallas, Tex., and one at Seattle, Wash.

The Utica Steam Gauge Company is mailing to its friends a remarkably handsome photogravure showing the simplicity of its pedal valve, so called because a touch of the foot will open or close it.

Mr. E. C. Ferguson, a well known member of the Chicago Electric Club and of the legal fraternity, is enjoying a combined business and pleasure trip to the Northwest and along the Pacific Slope.

The Dyer Electric Company, has been incorporated in Illinois, to manufacture, sell and license for use the Dyer electric system; the capital stock is $10,000,000 and the incorporators are I. T. Dyer, H. S. Dickson and G. W. Huddleston.

St. Louis Exposition.—A St. Louis paper says in describing the exhibits to be made at the coming exposition in that city: "The climax of endeavor, however, will be the electrical display, which will again be under the supervision of Mr. Whipple. The director of this department will be in St. Louis about the first of August."

The Missouri River Power Company has begun the construction of a dam across the Missouri River near Helena, Mont., to develop about 20,000 h. p. The power developed is to be transmitted electrically to Helena, 13 miles distant. The total cost is estimated at $100,000. Robert J. Johnson, of Helena, is chief engineer and E. F. Fuller, of New York city, is consulting engineer.

Mr. George Burdge, of North Manchester, Ind., has sold his remaining half interest in the electric light plant at that place to Mr. J. A. Browne and Mr. Henry Mills, both of the same place. The capacity of the plant is 25 arc lights and 200 series incandescents of the Indianapolis Jenney systems. Mr. Burdge may still continue in the electric light business in another field. His partner in the North Manchester plant was Mr. John W. Boger.

A Trunk Line Railway.—Mr. C. H. Talmage, of Kansas City, Mo., recently closed a contract for building and equipping complete an important trunk line of electric railway at St. Louis, Mo. It extends from a connection with the St. Louis and East St. Louis Electric Railway now running across the St. Louis bridge, through East St. Louis to the city of Belleville, on the route now occupied by the horse car line. The total length of the line is 19 miles.

Our Flag.—Mr. R. A. Campbell, of Chicago, has issued a neat little brochure showing "the origin, evolution and history of the Stars and Stripes," and mentions therein that the famous electrician Benjamin Franklin, was one of the first "to impress upon the people the necessity for united and co-operative action" in the proposed struggle for their rights, and that to Franklin is nearly all the credit due for securing the old colonial flag, out of which came our Stars and Stripes.

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$298@$300	Cumberland	$ 59@ $60
Central Union	68@ 69	Wisconsin	116@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 23
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$104@$105	Chicago Edison Co	$125@$130

The Electricians' Time Company, of Chicago, is the name of a newly formed corporation organized on a substantial basis for the purpose of furnishing watches, jewelry, precious stones, etc., to the members of the electrical fraternity at fair prices, and for handling specialties in the jewelry line. The company is well indorsed and has several prominent members of the Chicago Electric Club on its board of directors. The secretary and manager is Mr. John Brison, a gentleman thoroughly acquainted with this line of business, having held a similar position with Giles Bros. & Co. for some ten years, while Mr. L. W. Collins, formerly manager of the Chicago Electric Club is prominently identified with the new company.

Mr. J. P. Barrett, electrician of the City of Chicago, has a large album in which has been placed the signatures of nearly 1,000 representative men belonging to the electrical industries, all of whom have gladly indorsed the petition Mr. Barrett's friends have been circulating in his behalf. Seldom, if ever, have so many prominent names been gathered within the covers of one book, and as time passes on it will grow more valuable, and will aid in recalling many pleasant memories of the active, successful men who built up within the short space of fifteen years an industry in which $600,000,000 are now invested. Was such enterprise ever dreamed of before? And yet it may be slight in comparison with what the next ten years may bring forth. F. DE L.

SOUTHERN NOTES.

NORFOLK, VA., August 2, 1890.

Troy, Ala.—The city government is negotiating for the establishment of an electric light plant.

Greenville, Tex.—An electric light will be established and parties are engaged in organizing a movement to that end.

Will Buy a New Outfit.—The electric light company of Sheffield, Ala., is preparing to buy new electric machinery.

Commenced Running.—The new electric street railway at Charleston, W. Va., is completed and the cars commenced running this week.

Blacksburg, S. C.—The new electric light system is completed and now in operation to the satisfaction of the citizens. The light placed upon the top of Mount Whitaker can be seen for miles around.

The Equitable Electric Company has been incorporated at Alexandria, Va., with J. M. Glover, of St. Louis, Mo., as president and C. W. Field, Jr., of New York city, secretary. The capital stock is $500,000.

Newport News, Va.—A general meeting of the stockholders of the Newport News Light and Water Company is called to meet on the 20th of August for the purpose of proposing amendments to the company's charter.

The youngest telegraph operator in the world in charge of an office is believed to be Otis Bass, an eleven-year-old boy, who has charge of the office at Germantown, N. C. He is a bright, energetic youngster and a rattling good operator.

Goldsboro, N. C.—The electric light plant of the city has been bought by Messrs. I. F. Dortch, B. M. Privett and J. C. Eason who have associated themselves under the name of the Goldsboro Electric Light and Power Company, with a capital stock of $25,000.

Birmingham, Ala.—A stockholders meeting of the Birmingham Railway and Electric Company was held on the 26th ult. The company decided to issue $1,500,000 negotiable first mortgage consolidated bonds to aid them in getting the affairs of the company on a firm basis and to make contemplated improvements.

Savannah, Ga.—The City Council has passed the ordinance granting the Savannah Street and Rural Resort Railroad Company, the City and Suburban Railroad Company and the Coast Line Railroad Company the right to operate their respective lines by electric power by the overhe d trolley system of electric wires.

A Hello Accident.—By the crossing of an electric light wire and a telephone wire a few nights ago in Macon, Ga., one of the cables at the telephone exchange was burned out, damaging about 50 wires so that they could not be used. Manager Muelerix, with his usual promptness and energy, lost no time in repairing the damages.

Chester, S. C.—A meeting of the citizens of the town a few nights ago voted to authorize the town council to contract for obtaining electric lights, provided it can be done at a cost not exceeding $2,000 per annum. An agent of the National Electric Company was at the meeting, and guaranteed an ample electric lighting of the town at the figure named.

Charleston, S. C.—The Enterprise Street Railway Company has under consideration the advisability of changing its plant to an electric road. This matter has not yet been fully settled, but it is understood that numerous plans and specifications have been submitted to the city authorities, which are now being considered. When the requisite authority is obtained the road will not delay in giving Charleston an electric railway.

A New Electric Motor.—Mr. R. W. Traylor, of Richmond, Va., has recently invented a new electric motor for street railways, and for stationary purposes. He has been awarded a patent on his invention. The motor is described as being a very compact and powerful machine. A company has been incorporated to manufacture and sell these motors and other electric apparatus, appliances and equipments, and to establish electric plants in Virginia and elsewhere, for furnishing electric power and lights. The capital stock is to be not less than $100,000, nor more than $300,000, divided into shares of $100 each. The company is authorized to own 500 acres in any state. The principal office will be in Richmond, but branches are to be established wherever the board of directors deem it necessary. The officers are as follows: President, A. W. Garber; vice-president, Thomas Potts; secretary, J. E. McKenney; treasurer, Meredith F. Montague; superintendent, R. W. Traylor. Directors: Messrs. A. W. Garber, J. Taylor Ellyson, J. L. Taliaferao, Wist. E. Taylor, R. F. Hudson and Thomas Potts.

Y. N. B.

ENGLISH NOTES.

(*From our own correspondent.*)

LONDON, July 23, 1890.

Lamps in the Colonies.—The Brush Company, which recently tried to upset the Edison English lamp patent, has acquired the control of these for Australasia, India, Cape of Good Hope and Natal, and has issued an advertisement warning any one from importing, selling, manufacturing or using any lamps but its own in these territories.

Central London Railway.—The radical party feels much aggrieved that the bill for the electric subway should have been thrown out by the House of Lords. It is said that the supposed danger to St. Paul's Cathedral brought the weight of the bishops' influence, and that this turned the scale. At all events the engineers will now have an opportunity of gaining solid experience from the Southwark line below the Thames and will be able in a year or two to bring strong practical evidence with them.

Manufacturing Companies.—Crompton & Co. have declared a seven per cent. dividend on preference, and five per cent on ordinary shares. They are very busy building central stations and in teaching other companies, such as the Westminster Supply Company, how to lay street mains in conduits and pipes. The Edison & Swan United Company has declared a dividend of seven per cent. on A shares, and four per cent. on cumulative preference shares arrears, which is very satisfactory, considering its large capital. The monopoly of lamp making does not contribute to the popularity of this company.

Meeting at Edinburgh.—The special meeting of the Institution of Electrical Engineers at Edinburgh was a great success. An important paper by Professor Ayrton and his assistants was considered to be too formidable for thorough discussion on a holiday meeting; the fact being that hardly any one present had any knowledge of the subject that could be compared with that which had been acquired by the laborious experiments which the authors had carried out. Dr. Walmsley's idea of describing the most interesting features of the exhibition in a paper, and then acting as showman, and escorting parties round the place, was an excellent one, both from the sightseers' and the exhibitors' points of view.

The Agitation Among the Telegraph Clerks.—As I have mentioned in previous letters, we have for some time past been face to face with a very formidable agitation among the Postal Telegraph clerks all over the country. In London, which has been the chief focus of discontent, the operators at the central telegraph office finally decided to refuse to work overtime unless their grievances were remedied by July 12. The failure of the postmens' strike, however, had its effect in damping the ardor of the telegraphers and the critical date passed without any attempt at a general refusal to work overtime. On Tuesday the *Times* contained a brief résumé of the results of the labors of a committee appointed by the Postmaster General to inquire into the causes of this agitation, and it was the lengthy deliberations of this committee that the more ardent spirits among the agitators were desirous of cutting short by a strike. The recommendations of the committee, which have received the sanction of the treasury, affect some 10,000 post office employés (telegraph operators and "sorters"), and will cost the country not less than £200,000 per annum. In addition to this increase of pay, further advantages have been accorded to the staff throughout the country in the matter of overtime, Sunday work, Bank Holiday work and sick leave.

Compound Winding.—The Court of Appeal has decided against the Brush compound winding patent, on the ground of prior publication by Varley. The experts on the Brush side spent a great deal of trouble in attempting to show that Varley's patent was not good. This had nothing to do with the case, for the patent, such as it was, expired long ago. They also pushed the commutator question to a rather ridiculous extent, arguing as to whether there were nicks in the heads of the screws. The court, however, kept the simple question before it, and found that Varley had made a machine in 1876, which had both series and shunt coils, and which was connected up in the manner now common with compound-machines. Many makers have been paying ten shillings per thousand watts output on their compound wound machines, but of course nothing has been paid since the first decision which is now upheld. The former case, got up by Crompton in 1887, was backed by so few other firms that they found that it would be cheaper to pay the royalties than to fight. The general impression is that Brush was not thinking about distribution at constant potential when he invented the teazer; and the English Brush Company in acquiring his patent bought "a pig in a poke," which after several years appeared to be valuable, since it might be held to include the subsequently invented method of compound winding.

News of the Week.

THE TELEGRAPH.

Telegraph Poles Burned.—At a fire in Chicago last week 500,000 telegraph poles, which were piled up near the mouth of the Chicago river, were destroyed.

The Postal Telegraph Company's Employes, in this city, assert that their salaries have been so divided under the provisions of the weekly payment law, that their earnings are reduced from 23 to 30 cents per week.

Pushing Toward Central Africa.—The telegraph line from Cape Town, Africa, has just been opened as far as Mafeking, in British Bechuanaland. It will now be extended northeast to Tati in Matheleloland, with a branch to the capital of Lobengula, the King of that country.

Postponed.—The time of holding the annual convention of the Old-Time Telegraphers and the United States Military Telegraph Corps has been postponed from Sept. 10-12 to Sept. 15-17, so that there would be no conflict with the convention of the National Telephone Exchange, to be held in Detroit at that time.

Dividend.—The Anglo-American Telegraph Company has declared in London an interim dividend for the quarter ending June 30, 1890, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, payable on Aug. 1. These are the same rates as those paid for the corresponding period of last year.

To Extend its Lines.—The New Jersey Postal Telegraph Company, planning to further its project of extending its lines through Newark and its neighboring towns—Plainfield, Somerville, Bound Brook, Woodbridge, Long Branch, and other places—will apply to the various municipal bodies at early meetings for permission to erect poles on the streets and string the necessary wires.

Gratitude to the Employes.—The following letter has been transmitted by Mr. Thos. T. Eckert, vice-president and general manager of the Western Union Telegraph Company to Mr. Chas. A. Tinker, the general superintendent. Mr. Eckert says: "It has been a source of great gratification to me, and the subject of favorable comment by the members of the various committees of the company, that the recent destruction of the operating and adjacent departments by fire has exhibited in the most practical way, the loyal zeal of our employés. To their untiring industry and efficient co-operation is due, in the largest degree, the praises of the press and public upon the skillful way in which the circuits and facilities were extricated from their apparent hopeless confusion. I have yet to hear of any expression other than that of the desire of everyone to contribute his or her help in the most marvelous re-establishment of the service, which has been accomplished. In my long telegraphic experience this calamity was the most serious that has befallen us, and I may add, to their honor, that the way in which it has been surmounted reflects the greatest credit upon the intelligence and usefulness of all concerned. It has always been my contention that these qualities were distinguishing marks of the general body of telegraphers, and I take pride in the proof of my belief, even if its exhibition must be coupled with a disaster-bearing event The object of this note is, therefore, to request you to express to the heads of your subordinate departments, and through them to every employé in those departments, the appreciation of the committees and executive officers of the company for the assistance and service which they have so ungrudgingly rendered."

In transmitting this letter to Mr. W. C. Humpstone, the superintendent of the First District, Mr. Tinker says: "I take great pleasure in transmitting the attached copy of a letter from the general manager, which speaks in eloquent words his sentiments regarding the experiences and service which marked the closing weeks of the eventful month of July. . . . We will answer back in a hip! hip! hurrah! and long life to the sturdy pilot at the helm who never lost sight of the needs of the hour, but from his post of command took in the whole situation, and gave us such consolation, and now modestly gives all credit to the crew. Let us all hope that the disaster may prove a blessing in disguise, and stand fast to our trust."

THE TELEPHONE.

Dividend.—The Erie Telegraph and Telephone Company, has declared a quarterly dividend of one per cent., payable Aug. 18.

A new metallic telephone line has been constructed between Worcester, Mass., and Boston, to accommodate the increased business which is growing up between these cities.

The Erie Telephone Company met on Friday of last week to consider the matter of dividend. The earnings of the company, estimating June, will enable a dividend of one per cent. to be paid and reserving of a surplus of not less than $5,000, in addition to the payment of the American Bell Telephone Company's proportion of the earnings.

Bond Filed.—The bond of the Pacific Telephone and Telegraph Company in $10,000, required by the terms of the franchise granted to that corporation to construct underground conduits for the transmission of electricity, has been filed with the Board of Supervisors at San Francisco, Cal.

An Injunction Secured.—The Southern New England Telephone Company has obtained a temporary injunction restraining the North American Construction Company, of Pittsburg, from

erecting the plant of the Windsor Locks (Conn.) Electric Light Company. The object of the telephone company is said to be the prevention of trouble from induced currents.

Exchange at Seneca Falls, N. Y., Burned.—The Empire State Telephone office was entirely burned out in the big fire which occurred on the 30th ult., together with the Western Union Telegraph office. The telephone company opened a temporary office in front of the Stanton House at 9 o'clock, and at 12 was working in a new block. The telegraph company is using the New York Central wire.

Decision as to Service of Process Against Corporation.—Service of a summons against a telephone and telegraph company on its general superintendent, an officer having charge of one of its departments, has been decided to be a service on a "managing agent," under Code Civil Proc , N. Y., Sec. 431, providing that service of a summons upon a domestic corporation must be made by delivering a copy thereof within the State "to the president or other head of the corporation, . . . or a director or managing agent." This decision was rendered in the case of Barrett v. American Telephone & Telegraph Company, in the Supreme Court of New York.

A record of daily calls is being made at the Grand Rapids (Mich.) Telephone Exchange by the local manager, Mr. Boyce. Beside each operator is a cigar box with two compartments. Every time a connection is made a pea is dropped in the box, and when night comes they are counted and the daily connections determined. The count which was recently made for a single day in the middle of the week shows that for 24 hours the total number of calls was 10,634; during the ten business hours, 9,076 connections were made; the busiest hour was from 9 to 10, with 1,341 connections; largest number on one board in 24 hours, 958; in one hour, 173. The next day's business for 24 hours was 10,744 connections; 10 business hours, 9,202; busiest hour, 9 to 10, 1,279; one board in 24 hours, 937; one board in one hour, 147. On Saturday the count was only from 1 to 12, the total connections being 4,441; busiest hour, 9 to 10; one board in one hour, 137. The exchange has 1,400 telephones in use, an average of one for 50 inhabitants of the city. Last year this exchange had more instruments and more calls per inhabitant than any other place. Mr S. E. Watson is superintendent of the exchange.

THE ELECTRIC LIGHT.

Newton, Ia., voted $13,000 for an incandescent plant.

London, Ont., is to introduce arc lights upon the streets.

Monroe, N. C.—It is proposed to erect an electric light plant.

San Francisco, Cal., will place incandescent lights in the city post office.

West Point, Ga.—It is reported that an electric light plant will be constructed.

St. Petersburg, Fla.—An electric light plant will probably be put into the Hotel "Detroit."

Little Rock, Ark.—It is reported that the city will put in a new dynamo in its electric light plant.

Hulings, W. Va.—The Hulings Lumber Company thinks of putting in an electric light plant.

The New Brunswick Electric Light Company has been incorporated with a capital stock of $250,000.

Pulaski City, Va.—J. B. Baskerville, mayor, will receive proposals for the erection of the electric light plant.

Brinkley, Ark.—The Electric Light and Power Company has let the contract for the sinking of an artesian well.

Elmira, N. Y.—The board of trustees has refused to allow the gas company the privilege of operating an electric plant.

Blaine, Wash.—The new electric light plant now being erected will have a capacity of 70 arc and 600 incandescent lights.

Kingston, Can.—Electric lights will soon be introduced into the Kingston penitentiary, as the plant is now about ready.

Hastings, Neb.—Manager Johnson, of the electric light company, has recently added a new 50-arc light dynamo to the lighting plant.

Baker City and Ashland, Ore., have each contracted with the United Edison Company for an electric light plant of about 1,000 lights.

White Plains, N. Y.—The White Plains Gas and Electric Company has asked the Board of Trustees for a five years' contract for gas lamps at $30 per lamp.

Springfield, Mass.—The local electric light company has voted to increase the capital stock to $20,000, and the extra amount is being rapidly taken by local business men.

Waynesboro, Ga.—Mr. R. A. Scott, secretary of the recently organized electric light company, will receive bids for the construction of a plant. The stock has been all subscribed.

A Portable Theatrical Plant.—A dynamo and a complete electrical plant will be carried by "The Limited Mail" Company, to produce the telegraph and other effects in that play.

Nashville, Tenn.—The Board of Public Works has decided to light up the Capitol grounds with electricity until Oct. 1, beginning at once, and lighting up every night in the week.

Shelby, N. C.—The Shelby Land, Loan and Improvement Company, organized with a capital stock of $150,000, proposes to erect and operate an electric light plant and an electric railway.

Nevada, Miss.—The Parrish Electric Light, Power and Heat Company has been organized, with Samuel Brown as president and Eugene Parrish as secretary. The capital stock is $120,000.

Bids will be received until September 1 for an electric light plant for the Mare Island Navy Yard by the Bureau of Docks and Yards, Washington, D. C. The appropriation amounts to $45,000.

Augusta, Ga.—D. B. Dyer, R. M. Spivey, R. R. Conklin, and others will incorporate the Augusta Electric Light and Motor Company to supply electric light, heat and power. The capital stock is to be $50,000.

Increase of Capital.—The Edison Electric Light and Power Company, of Kansas City, has increased its capital stock from $100,000 to $150,000. The company's assets are $125,300, and its liabilities $25,200.

The New Jersey Investment Company has been incorporated in New Jersey to manufacture and set up electric light plants. The principal place of business will be Jersey City, and the capital is set at $1,200,000.

A Twenty-five Year Franchise.—The Los Angeles Electric Light Company has been operating its lighting plant for about eight years without a franchise. It now asks the city to grant it a franchise for a period of 25 years.

Salem, N. J.—Superintendent A. O. Foss, of the Salem Electric Light Company, has resigned his position, and will leave for a trip South. He has been superintendent of Salem's electric lights ever since the establishment of the plant.

Cost of New Central Station.—The contract for the mason work for the Edison Electric Light Company's new power house at Milwaukee, Wis., has been awarded for $12,600. The iron work will cost $8,000, and the cut stone $3,400.

Spokane Falls, Wash.—The linemen who went out on a strike last week for higher wages or shorter hours have returned to work without obtaining any concession on these points, their present time being ten hours and wages $2.75.

Three Rivers, Mich.—The Westinghouse Electric and Manufacturing Company has just sold a 40-light dynamo of its alternating current arc light system to go to Three Rivers, Mich., to be used by the electric lighting company of that town.

Washington, Ga, is to be illuminated by the alternating current system of electric lighting. The Westinghouse Electric and Manufacturing Company has been awarded the contract for the installation of its apparatus for a capacity of 500 lights.

The Monongahela City Electric Company, an organization lately established, has just concluded negotiations with the Westinghouse Electric and Manufacturing Company for alternating current incandescent apparatus of 750 lights capacity.

Lighting Plant for the White House.—An amendment to the civil appropriation bill has been reported by the Committee on Appropriations and agreed to by the Senate inserting an item of $7,700 for introducing electric lights into the Executive Mansion.

Asheville, N. C.—A. J. Lyman, the National Electric Manufacturing and Construction Company, J. E. Dickerson and others have incorporated the People's Light, Heat and Power Company to erect an electric light and power plant. The capital stock is $50,000.

The Davenport (Ia.) Light and Motor Company has filed articles of incorporation in the recorder's office at that place. The capital stock is placed at $100,000 and the incorporators are M. L. Marks, N. Kuhnen, Jr., A. J. Hirschl, R. T. Miller, Lee E. Cole and others.

Schuylerville, N. Y.—Schuylerville's excitement over the trouble between Rev. Father Heffernan and the electric light company is not yet abated. The Supreme Court has permanently enjoined the priest from interfering with the company in placing a pole in front of the church.

Struck by Lightning.—The cottage of Mr. John E. Rockefeller, vice-president of the Asbury Park Electric Light Company, at Fourth avenue and Emery street, Asbury Park, N. J., was struck by lightning and slightly damaged during a heavy thunder storm on Friday night of last week.

Electric Lighting by Water Power.—A dam is to be built across the Des Chutes river, near Olympia, Wash., giving a 30 foot waterfall. It is estimated that this will give from 400 to 600 h. p. Six dynamos will be placed at the falls to generate current for electric light and power purposes.

Storage Battery Plant.—The Pacific Electrical Storage Company has sold a lighting plant to the Grant's Pass (Ore.) Electric Light Company for a central station. It will be a 500-light plant. This is said to be the first central station storage battery plant on the Pacific Coast, outside of California.

Perth Amboy, N. J.—The Raritan Electric Light and Power Company is doing quite a flourishing business. It has in use at the present time 94 arc lights and over 500 incandescent lights, and orders are coming in rapidly from merchants, manufacturers, etc., and every body appears to be well pleased with the service.

Alternating Arc Lights—The great advantage of the new Westinghouse alternating current arc light system would seem to be daily growing more apparent. In Moline, Ill., and at the Jarecki Manufacturing Company's works, Erie, Pa., that system is being installed now to the extent of 24 lights in each place.

Lighting Contract Closed.—The city authorities of Lawrence, Mass., have contracted with the Lawrence Gas Company to furnish 70 arc lamps of 2,000 c. p. each at $100 per year each, and with the Edison Illuminating Company for 500 or more 20 c. p. incandescent lights at $1.50 each per month, to burn until midnight, and for 150 similar lights, to burn all night, at $3.04 each.

Lighting Plant Destroyed by Fire.—A very destructive fire occurred at Seneca Falls, N. Y., on the 30th ult., in which the Thomson-Houston electric light plant was entirely destroyed. The loss is estimated at $100,000, with only $10,000 insurance. The company has already made arrangements for starting a new plant in Johnson Hall, and it is expected that the village will be lighted by electricity again within three weeks.

Pay for Naval Lighting Plants.—The General Deficiency bill, now pending before Congress, provides for the payment of $500 to Commander Royal B. Bradford of the navy for services in installing an electric light plant in the Interior Department. Commander Bradford was at the time Inspector of Electric Lighting in the navy, and was ordered by the Secretary of the Navy to do this work under direction of the Secretary of the Interior.

A New Station.—On this site purchased some time ago by the Haverhill (Mass) Electric Light Company, it is now proposed to erect a brick building with foundation and suitable equipments for a 2,000 h. p. station, to be equipped at present with 1,000 h. p. of dynamos for power purposes. The present dynamo capacity is 375 h. p. The upper portion of this building will be fitted up as a shoe factory, for which it will be particularly adapted owing to the convenience of obtaining power.

The Spokane Falls Electrical Society, at its last semi-monthly meeting, had a paper read on "The Proper Care of Dynamos," by M. M. Gorsline, chief dynamo engineer of the Edison Electric Illuminating Company. The paper was very practical and to the point, and the members present derived great benefit from it. The paper announced for the following meeting was to be given by Mr. Richard Fleming, of the Edison Company, on "Alternating Current and Direct Current Systems."

New Companies at Amsterdam, N. Y.—The Edison Electric Light Company has been organized as follows: President, John S. Wise, New York; directors, John H. McClements, F. S. Hastings and Eugene H. Lewis, New York, and John K. Warnick and John Sanford, Amsterdam. The Amsterdam Arc Light Company has also been organized as follows: President, R. L. Harrison, New York; directors, John H. McClements, T. D. Mosscrop, John S. Wise, New York; John K. Warnick, Amsterdam.

Denver, Colo.—The Consolidated Electric Light Company has instituted legal proceedings to secure the annulment of the contract recently made between the city and the Western Electrical Construction Company for the arc lamps on the streets, on the ground that the City Council has no right to make a contract extending over more than one year. If the point is well taken the contract of the Consolidated with the city for incandescent lamps must also be null and void, as it, too, covers a period of five years.

Grand Rapids, Mich.—The city's Committee on Lamps has reported in favor of lighting the city for the coming year by awarding the contracts as follows: Grand Rapids Electric Light and Power Company, arc lights at $109.50 per lamp per year and incandescent lights on Leonard street bridge at $16 per light; Grand Rapids Gas Company, each light to be lighted on each dark night until midnight at $12; Globe Light and Heat Company, 1,500 lamps on the same conditions as the gas at $14. The report was accepted and adopted.

Bids for Lighting Plants.—Tenders for the construction of an electric lighting plant at Detroit, Mich., were opened recently before the Fire, Water and Gas Committee with the following result: Ball Company, Toronto, $8,788; Reliance, Waterford, $9,950; Fort Wayne, $12,100; United Edison, Schenectady, N. Y., $13,200; Royal, Montreal, $15,150; Western, Chicago, $16,762. The bids for machinery and boilers were as follows: Leonard & Sons, London, $3,095; Watrous Engine Company, Brantford, $3,600; Goldie McCullough, Galt, $3,975; United Edison, Toronto, $4,000.

Crafton, Pa., on the Pan Handle, one of the prettiest of Pittsburg's suburban villages, is soon to be lighted by electricity. One of the incorporators of the Crafton Electric Lighting Company, recently chartered, said the other day that the plant would be constructed in the near future. Street lighting is to form a part of the system. Crafton is also living in hope of being blessed with a street railway before the leaves begin to fall. The West End Street Railway Company, of Pittsburg, is looking Craftonward with a good deal of determination and the field is an inviting one.

A Search Light on the Lakes.—Mr. S. D. Nesmith, of the Central States district of the United Edison Manufacturing Company has placed a search lamp on the steamer "Progress," a vessel plying between Ashtabula, O., and Escanaba, Mich. The lake captains who saw it in use the first night of its operation were very much pleased with it and believe it will be of great benefit to them in the future, as there are a great many shoals and narrow passages, which render navigation on the lakes very dangerous, as these passages are only marked by stakes and buoys with no lights. With the aid of the search lamp these shoals can be located to such advantage that night navigation, in the future, will be comparatively easy.

Westinghouse Dividend.—The Westinghouse Electric and Manufacturing Company's directors on Saturday of last week elected Mr. N. W. Bumstead, of Boston, to the board, extended the time to subscribe for new stock from Aug. 1 to Aug. 20 and the time of payments to the 20th of August, September, October and November. It was also voted: "That from the net earnings of the company a semi-annual dividend of 4 per cent. upon the capital stock be and the same is hereby declared, payable Sept. 1, 1890, in scrip of the company, to the stockholders of July 31, 1890, the said scrip to be payable Sept. 1, 1900; to be redeemable after 60 days' notice on the first days of March and September in any year prior to the date of maturity, at the option of the company; or to be convertible into the stock of the company at par at the option of the holder; certificates to bear interest at the rate of 6 per cent. per annum, payable semi annually on the first days of March and September, to holders of record; certificates to be convertible into the stock of the company only when presented in sums of $50 or multiples, and to be transferable on the books of the company only in person or by attorney." It was further voted that the transfer books be closed July 31 and Aug. 1.

APPLICATIONS OF POWER.

Kansas City, Mo.—The property of the Ivanhoe Park electric line has been turned over by its constructors, the Thomson-Houston Company.

Knoxville, Tenn.—The Knoxville Street Railroad Company has, it is reported, purchased the Elmwood dummy line, and will extend it, using electricity as the motive power.

Not Kicking.—It is said that electricity is crowding the mule, as a motive power, off the street railway lines of Indianapolis, Ind. For once, however, the mule is not kicking.

Shelby, N. C.—The Shelby Land Loan and Improvement Company intends to construct an electric railroad to Cleveland Springs. The secretary of the company can give information.

A New Street Railway Company has been organized at Olympia, Wash. It is known as the Bellingham Bay Electric Street Railway Company, and has a capital stock of $200,000.

Electric Cars Running.—The cars on the electric line on Santa Fe avenue, Pueblo, Colo., began running last month. There were no delays and everything is reported in good working order.

Vancouver, B. C.—The electric street railway, opened for traffic last month, is doing a large business, and the line will be extended without delay. The new system of arc lighting on the streets is also in operation.

A Street Railway Sold.—A syndicate of capitalists has made a contract for the purchase of a majority of the stock of the Glens Falls, Sandy Hill and Fort Edward Street Railway, in New York State. Under the new management electricity will replace horses as a motive power.

Hutchinson, Kas.—Mr. A. L. Bigger, president of the Hutchinson street railway, recently returned from an extended tour of inspection of electric railways in Boston, New York and Washington. He intends to construct 15 miles of electric line in Hutchinson and equip it with 15 electric cars at once.

Electric Road Earnings.—The report of the Watervliet (N. Y.) Railroad Company, which has recently adopted electricity as a motive power, for the quarter ended June 30, shows a net income of $6,206, against a loss of $1,519 in the corresponding period of last year. The gross earnings for the quarter were $32,386.

Electrical Dental Apparatus.—Mr. R. B. Elder, electrician of the Pacific Electric Storage Company, at a recent meeting of the California Dental Association, gave some details of electrical dental apparatus, illustrating his remarks by showing some of the appliances now in use by leading dentists of the Pacific states.

Waterbury, Conn.—The projected electric railroad between Waterbury and Naugatuck is now assured. The construction of the line will be begun early in August, and work will be pushed as rapidly as possible. The Thomson-Houston system of electric motive power will be used. The capital stock of the company is $50,000.

Under Construction.—Work began last month on the Cicero & Proviso electric street railway in Chicago, Ill. A force of 500 men commenced digging at Fortieth and Madison streets. The lines will run on Madison and Lake streets, West Chicago avenue and Twelfth street from Fortieth west to the suburbs along the Des Plaines River.

Putting in New Engines.—Two new engines are being placed in position at the power station of the Second avenue electric line, Pittsburg, Pa., and when these are completed the company will be able to put on 25 cars if necessary. During the time the new engines have been under construction only one engine and five cars were running.

To Inspect New Poles.—The Grand Rapids Electric Railway Company has asked the City Council that a committee be appointed to inspect and approve the new poles to be used in its new lines, and the matter was referred to the Committee on Streets

with power to act. It was afterward reconsidered and action postponed for some time.

New Castle, one of the wide awake towns of western Pennsylvania, will have an electric street railway in operation within a short time. The road is one and a half miles in length, and the builders are disposed to crow over the fact that this length of track was put down in four and one half working days. They say this is the quickest piece of street railway work on record.

Electric Railway for New Mexico.—H. E. Pike, a wealthy, gentleman of Philadelphia, has succeeded in organizing a company to build a line of electric railway in Albuquerque, N. M. The company has a paid-up capital of $75,000. The Council has granted a franchise and it is the intention to build a circular line about 20 miles in length. Among the board of directors are several New York capitalists.

The Railroad Committee of the Orange Common Council decided at a recent meeting to report a resolution giving the electric franchise to the Newark Passenger Railway Company on certain stipulated conditions. The road is to be operated by electricity by the overhead system, with poles placed in the centre of the streets between the tracks wherever the width of the street is sixty feet or over.

The Central Traction Company, of Pittsburg, has just placed in position a new cable. The road of this company has been in operation for but four or five months, but the first cable had been completely worn out. As the experience of the Central Traction Company has many counterparts, it would seem that any street railway company ignoring the claims of electricity when construct ing its line is not acting wisely.

The Pittsburg and Birmingham Traction Company, whose line runs to that part of the city of Pitts burg known as the South Side, was confronted by a posibility of competition recently, but by a timely purchase removed its rival from the field. The company is now erecting a handsome power house of brick which will cost many thousand dollars. It will adopt the electric system of propulsion in the near future, but at present is relying on the strength of the mule.

Railway Extension at Denver, Colo.—The Tramway Company has come to the conclusion that its Lawrence street electric line has become so popular that it will stretch another arm of it through the city. The new line will begin at the corner of Curtis and Twenty-second streets. It will run up Twenty-second street across the Welton street cable line up to Twenty-second avenue, and out that thoroughfare to Downing, and from thence to the suburbs. Work has already begun upon tracklaying.

The Interstate Water and Electric Power Company is about to be organized at Kansas City, Kas., with a capital stock of $1,000,000, to establish an electric power plant near Muncie, in Wyandotte County, where the Kaw river will be dammed to ob. tain water power. Already 203 acres of land have peen purchased, 173 acres on the north side and 30 on the south side of the river. The directors of the company are: John B. Colton, Nicholas McAlpine, David N. Carlisle, Robert L. McAlpine and John S. Johns.

Street Railway Officers at Amsterdam, N. Y.—The directors of the Amsterdam Street Railroad Company, which will soon run its cars by electricity, have elected the following officers: President, E. H. Johnson, New York; vice-president, J. H. McClements, New York; secretary, M. L. Stover, Amsterdam; treasurer, David Cady, Amsterdam; directors, John S. Wise, E. H. Lewis, R. L. Harrison, George H. Fearus, T. D. Mosscrop and A. S. Beves, New York, and Henry Herrick, James H. Bronson and Willis Wendell, Amsterdam.

North Yakima, Wash.—The Yakima Street Railway and Power Company has been formed, with a capital of $100,000. The incorporators are Wayne Ferguson, M. V. Massey and L. McLean, of Spokane Falls, and Edward Whitson and L. S. Woodward, of North Yakima. The company will at once begin to lay three miles of track for electric motors. One hundred men are now engaged in putting up the poles and wires for the electric lights. This force will be doubled at once, and Superintendent Woodward proposes to have the electric lights in operation by the last of August.

A New Electric Line.—A company is being organized in Kansas City, Mo., for the construction of an electric street railway that, when completed, will be about seven miles in length. There are twelve men of means associated in the scheme, eight of them living in Kansas City, two in St. Louis and two in Chicago. W. B. Morehead and Dr. W. W. Radford, of Kansas City, are two of the leading members of the company. The capital stock is $100,000 and the money is ready and waiting to be expended on the work. The scheme is to connect with the electric line in Clay County that will start at the Winner bridge and run five miles north.

Fighting Against an Electric Road.—The village of Jamaica, Long Island, has brought action in the Supreme Court against the Brooklyn & Jamaica Railroad Company, to stop the running of electric cars in Fulton street, in that village. The plaintiff alleges that the railroad has taken possession of Fulton street for a mile and a quarter without permission, and has put up poles and wires in the streets. It is said that the defendant is about to lay a second track in the street. The defence alleges that it has a right to do all that it has done as successor of the Jamaica & Brookiyn Plank Road Company and other corporations. The court reserved decision.

New Lines for St. Louis.—The Union Depot and Mount City Street Railway lines, owned by Mr. John Scullin and a syndicate have authorized an issue of bonds amounting to $1,525,000 on the two properties. The sum of $1,000,000 will be applied to the Union Depot company's roads to give the Yellow and White lines electric-motor power, and $525,000 will be used in the reconstruction and change of the Mound City line. The success of the electric overhead wire system on the Blue line, together with the increased travel, has induced Mr. Scullin to make the changes above noted, as he estimates an additional traffic of 30 to 40 per cent. since the introduction of electricity.

Rockville, Md.—Mr. John E. Beall, of Washington, D. C., Spencer Watkins, James B. Henderson and Wilson Offutt, all of whom are interested in the proposed electric railway from Tennallytown to Rockville, met recently and announced that sufficient stock had been subscribed to call a meeting in the latter part of August to organize the company. They have also secured a majority of the stock of the Rockville & Georgetown Turnpike Company, and a right of way for the electric road has been granted by the county commissioners over what is known as the Old Road, which leaves the turnpike at Bethesda and strikes it again at or near Montrose. It is announced that the road will be completed as far as Bethesda by November.

Railways in Pittsburg, Pa.—Pittsburg has just now four electric street car systems in use. On the Second avenue line is employed the Thomson-Houston apparatus. But one motor to the car has been in use up to the present time, but it is now the purpose of the management to increase the effectiveness of the working by the addition to each car of another motor. There are a few pretty steep grades on the line, and the single motor is too severely strained. On the Pleasant Valley line the Sprague system does service. On this line is being used also a car equipped with the Westinghouse machine, which has been on trial for two or three weeks. On the new Oakland loop of the Pittsburg Traction Company is found the Short system. This loop does a good business, and the cars are said to "run like a streak."

Electric Railway Bonds.—First mortgage six per cent. gold bonds of the Dubuque Electric Railway, Light and Power Company, of Dubuque, Ia., to the amount of $160,000, are offered for sale by Messrs. Curtis & Motley, Boston, at par and interest. This company controls the principal street car business, and all the electric lighting and power business in Dubuque, a city of 35,000 inhabitants. It has the sole use of the Thomson-Houston patents in Dubuque. These bonds are secured by a first mortgage, limited to $160,000, on eight miles of street railroad, completely equipped, and on a large system of incandescent and arc lighting. The cost of the above has been over $200,000. The average monthly earnings of the company are approximately given as $5,050; expenses and all charges, including 15 per cent. for depreciation, $3,050; net, $2,000.

MISCELLANEOUS NOTES.

The Electrical Safety Railway Switch Company, has been incorporated at New Orleans, La., by C. A. Fish, A. W. Berne, J. W. Adams and others, with a capital stock of $100,000

Electrical supplies Wanted.—Mr. Campbell Scott, 1231 Third street, Louisville, Ky., desires the addresses of manufacturers of wooden cross arms, cleats, brackets, etc., for electrical use.

Incorporation.—The Kansas City (Kan) Fire Burglar Alarm and District Messenger Company has been incorporated with a capital stock of $60,000. The directors are A. M. Sloss, E. R. Wilder and E. F. Mullay, of Kansas City, Mo., and A. H. Cobb, H. McGrew and Winfield Freeman, of Kansas City, Kan.

Voting Machines for Congress.—The Congressional House Committee on Rules gave a hearing one day last week to John A. Enos, an inventor who seeks to have an appropriation of $60,000 made to defray the cost of installing his electric voting machine in the House of Representatives. Mr. Enos stated that during this session there have been over 300 roll calls, each consuming thirty minutes' time, or an aggregate of thirty working days, and he asserts by the use of his machine twenty-five days would have been saved.

Heliograph Invented by Mr. Edison.—A new heliograph devised by Mr. Edison, is to be tested from the top of Mt. Dunderberg, near the State Camp at Peekskill, N. Y. An effort will be made to signal to New York city, a distance of 40 miles as the bird flies. One station will be established in the camp, and another on the top of Dunderberg. Signals will be sent direct from the top of the mountain to the city, and also from the camp, through the station on top of the mountain, to the city. The work of putting up the instruments is now in progress.

Decision as to Electric Gas-Lighting Apparatus.—In patents No. 225,071, granted to Henry F. Packard, and No. 232,304, to Frank V. Sanford, for improvements in electric gas-lighting apparatus, the claims consisted of a combination of a gas burner, a fixed electrode, a ratchet, a pawl, a spring, a lever pivoted loosely on the stem of a stop cock, and having two arms, to one of which was attached an elastic contact point, and stop pin; the combination being so arranged as to open and close the gas passage to the tip at each alternate movement of the lever, and, conjointly with such opening, to ignite the gas by an electric spark, generated by such movement—devices which should, without actuating the gas cock, repeat the electric spark by the return movement of the opening devices to their normal position for further use. The Court has held that though some parts of the mechanism were old, the combination was new and useful, and the invention was patentable. This decision was rendered in the case of the Electric Gas-Lighting Company v. Fuller in the Circuit Court of the United States, District of Massachusetts.

Electrical Disturbances.—During the recent storm period in the south a number of electrical disturbances have been reported in several of which loss of life has been added to the destruction of property. At Raleigh, N. C., the lightning was very vivid. It struck the railroad track of the North Carolina Railroad Company, and damaged the depot of that road. The electric light wires were also struck and many telephones were burned out. At New Berne, N. C., the schooner "Marion Temple," lying at anchor in the harbor, was struck, and a hole made through the bottom by the electric bolt, sinking the vessel almost instantly. At Goldsboro, N. C., the switchboard of the Western Union Telegraph Office was destroyed, and the quarters otherwise badly damaged. In Berkely County, S. C., a woman was sitting with her two-year-old babe in her lap, and her husband standing at some distance away. The house was struck by lightning, the babe was killed instantly, and the father severely if not fatally shocked, while the mother experienced no shock whatever. A telegraph operator at the James River siding east of Lynchburg, Va., was struck but not fatally.

California Electrical Society.—The regular meeting of the California Electrical Society was held in San Francisco on the 21st ult. in the society's new quarters in the Murphy Building. Professor Keith occupied the chair, and a large number of electricians were in attendance. The new quarters are a great improvement on the old. The present quarters consist of two large rooms, one of which will be used as a meeting hall, and the other for a laboratory and library. It is the purpose of the society to provide one of the largest and most complete reference libraries on electrical subjects in the country. Already a large number of books have been secured, and the stock will be added to from time to time. Among the contributions received since the last meeting, in the way of electrical literature, is 12 bound volumes of THE ELECTRICAL WORLD, donated by Orion Brooks, Esq., and a treatise on magnetism, printed in 1629, and donated by W. L. Brown. At the recent meeting Mr. A. Hamlin entertained the members with an account of a peculiar death by lightning which came under his observation in Virginia. W. C. Quimby gave some results of observations on the effects of lightning.

The American Trade Press Association, an organization the relation of which in that branch of journalism is nearly identical with the Associated Press in daily journalism, has been organized with the following officers: President, C. R. Clifford, of Philadelphia; first vice-president, Henry R. Elliott, of New York; second vice-president, Clarence E. Stump, of New York; secretary, William M. Patton, of Philadelphia; treasurer, Benjamin Lillard, of New York. The board of directors are: W. L. Terhune, of Boston; Thomas Hudson, of Chicago, and Joseph W. Gibson, of New York. The following journals are members of the association: *The Farm, Implement News, Sanitary News, Western Brewer, Inland Architect,* and *The American Miller,* of Chicago; THE ELECTRICAL WORLD, *Druggists' Circular, The American Exporter, The Haberdasher, Jewellers' Circular, Dry Goods Economist, Bonforts' Wine and Spirit Circular,* and *The Clothing Gazette,* of New York; *The Upholsterer, Carriage Monthly, Paper and Press, Confectioners' Journal, Light, Heat and Power, Builder and Decorator,* of Philadelphia; and *The Boot and Shoe Recorder,* of Boston.

PERSONALS.

Prof. Elihu Thomson will read a paper before the New York meeting of the British Iron and Steel Institute in October on the "Thomson Electric Welding Process."

Mr. Geo. H. Blaxter, general manager of the Allegheny County Light Company, has just reached home from a very delightful trip to his birthplace, county Devonshire, England.

Mr. J. B. Lyon, of the Law Telephone Company, is in Philadelphia making preparations for the erection of the new switchboard which the Law company is to put in for the Bell Telephone Company.

Mr. N. W. Bumstead, of Boston, has been elected a director in the Westinghouse Electric and Manufacturing Company. The Westinghouse directory had up to Mr. Bumstead's election been composed entirely of local men.

Prof. Wm. A. Anthony, the president of the American Institute of Electrical Engineers, has been mentioned as a candidate for the position of electrical superintendent of the World's Fair in 1893. The name of Prof. Elisha Gray, of Highland Park, Ill., has also been prominently mentioned in connection with the same office.

Mr. James Dredge, editor of London *Engineering,* has been selected by the joint committee of the civil, mechanical and mining engineering societies of the United States to deliver the address at the unveiling of the memorial to be erected in honor of Alexander Lyman Holley in Washington square in this city. The dedication is to take place early in October, during the New York meeting of the British Iron and Steel Institute.

Mr. J. H. Gates, Texas district agent of the Westinghouse Company, was a recent visitor at the headquarters of the company in Pittsburg, Pa. Mr. Gates says Texas is rapidly growing in prosperity. The electric light daily becomes more popular, the electric railway has begun to generally displace the horse and mule; and fortunes are being made in real estate, which in many of the leading towns and cities is advancing in price with marvelous rapidity.

Mr. A. L. Register, one of the Thomson-Houston Electric Company's electrical engineers, passed through the city last Saturday on the way to Pittsburg, Pa., where he will have charge of the installation and operation of a new electric street railway. Mr. Register is a graduate of Cornell University, and has spent his entire time since graduation in acquiring some further practical information and in conducting some very complete experimental tests at the Lynn factory of the Thomson Houston company.

Mr. C. M. Hill, formerly with the Clark Electric Company was a caller at our office one day last week in search of information concerning prospective installations of electric mining apparatus and plants for the long distance transmission of power in the gold mining regions of Colorado. Mr. Hill is a firm believer in the ultimate development of the region along the Colorado river when the marvelous utility of electric power transmission becomes more widely known and recognized among the wealthy workers of Colorado mines.

Senator Davis, of Minnesota, now in the United States Senate, is said to be one of the oldest telegraph operators in the country. He was employed at and near Waukesha, Wis. When talking of his early experiences he said recently: "I sometimes find myself now listening to the old familiar ticking when I pass an instrument, but it soon gets beyond me. Like trying to count fence posts while whirling by a fast express train, four or five characters are distinct, and then they all run together in a jumble. The boys of to-day are too rapid for the veteran of '40."

Hon. Chas. A. Towne has been appointed by Gov. Brackett as a member of the Massachusetts State Board of Gas and Electric Light Commissioners, and the appointment was confirmed by the Senate. Mr. Towne is one of the most respected merchants in Franklin County, Mass. He served in the Legislature in 1883 and 1884, and was senator in 1887 and 1888, being placed upon some important committees. The other two members of the Board of Gas Commissioners are lawyers, and the Governor thought it best to appoint a business man for the third position.

Mr. William Henry Snell is the subject of a neat memorial pamphlet recently issued by *The Electrician,* of London, in honor of its late chief editor. It contains as a frontispiece a well-executed photogravure of Mr. Snell. The obituary notices which appeared in *The Electrician* of March 7 and 14, 1890, are reprinted. Along with other matter from his associates is printed a number of letters from Mr. Mordey, Mr. Fricker, Mr. Kapp, Prof. Fleming, Prof. O. J. Lodge, Mr. Reckenzaun, Prof. George Forbes and Mr. F. H. Webb, all of whom express a high appreciation of the value of Mr. Snell's friendship.

Industrial and Trade Notes.

Climax Tape.—Although the Boston Rubber Shoe Company has manufactured the Climax insulating tape for several years, not a pound has ever been returned, it is said, because it was not up to the standard.

The New England Pottery Company, of Boston, is doing a nice business with its celebrated "porous cups." Their goods are of the highest quality, and consumers who wish a battery that will last will do well to examine the quality of these cups.

The Edison-Lalande Battery has scored quite a point in its favor in this city. At the Western Union building 350 of these cells have been put in use by Mr. James F. Kelly, of the Edison Manufacturing Company, to replace a very much larger number of the cells in use before the recent fire.

The Illinois Electric Material Company, Rookery, Chicago, has been fortunate in securing the Western agency of the American Circular Loom Company's patent woven insulated wires, and is now sending out samples that are attracting marked attention for the strength and apparent durability of the insulation.

Messrs. Simons and Lewis of Boston, have invented a new type of primary battery which is claimed to give good results in electric lighting work. The refuse from the ingredients of the cell is said to be a useful article of commerce which can be sold for such a price that the original cost of operation of the cell will be greatly reduced.

William Webster & Co., of Philadelphia, have very thoroughly informed their patrons of the merits of the Webster vacuum exhaust steam economizer in a 72 page pamphlet recently issued. It is printed in colors, contains cuts of plants in operation, fac similes of testimonial letters and much valuable descriptive and explanatory matter. The New York office of this company is at 74 Cortlandt street.

Mr. Chas. A. Noll, 49 W. 22d street, in this city, has secured the contract from Mr. F. J. Sprague, to equip his new residence, corner 73d street and West End avenue, with interior electrical conduits throughout. This will be quite an extensive piece of work and besides this Mr. Noll, who is now making a specialty of interior conduits, has secured quite a number of other contracts for this class of work.

The Harrison Safety Boiler Works have shipped two of their celebrated safety boilers to the Toledo Consolidated Electric

Railway Company, of Toledo, O. Perhaps no better recommendation of these boilers could be had than the fact that since 1867 they have shipped Messrs. Cheney Bros., of South Manchester, Conn., he oldest and largest manufacturers of silk goods in this country, 28 of the boilers, aggregating 3,285 h. p.

The C. & C. Electric Motor Company, of New York, has been in the habit of saying that the number of its motors in actual operation was over 8,000. The very large output of the last six weeks has made it possible to raise this figure 25 per cent., and now the company is able to say that it has "over 10,000 motors in actual operation." The sales of this period have amounted to more than the company has ever before delivered in one entire year.

The Hadley Company, at Holyoke, Mass., is doing a good business in the electrical field. This company manufactures a superior fine yarn, that is well known to the textile trade, and it was the first in the country to turn its attention to spinning fine yarns, little thinking at the time that the day was not far distant when a large part of its finest product would be used for what was then an almost unheard of industry, the covering of electric wires.

E. T. Davis & Co., Lawrence, Mass., are making a great success with electrical companies with "Warner's Electric Bronze," which they put on the market some little time ago. This alloy is the result of several years of experimenting, and consumers who have used it for commutators and other similar service say that it is superior to anything they have used. It is sold at much less than the price of copper, wears very smooth and has great conductive qualities.

The Fibrone Manufacturing Compay, 25 Warren street, New York, is having very marked success with its substitute for hard rubber. The demand for this material has been so great that the company has been obliged to increase its factory by taking two additional floors. This material can be used as a substitute for hard rubber for all electrical purposes, and those who have used it have sent the company some very excellent testimonials as to its value for these uses.

The Great Western Electric Supply Company, of Chicago, are putting out armatures and intermediate pinions made of a substance not heretofore used. This is said to give a noiseless pinion and at the same time one that will outwear rawhide several times over. The company is anxious to receive trial orders from railway companies, believing that the result of a test will be their constant use. They themselves have tried them and found them, it is said, much superior to rawhide.

The Interior Conduit and Insulation Company, of New York, has been obliged to enlarge its office facilities at 16 Broad street, and has secured the use of another large room on the same floor as the present office. This room will be occupied by Mr. Edwin T. Greenfield, electrician of the company, and by the draughtsmen under his instructions. The company is now awaiting the delivery of 10 new machines for the manufacture of the interior tubing alone, and expects, with the aid of those, to fill all orders promptly.

Messrs. C. C. Sibley & Co., 418 West 26th street, New York, are making a specialty of supplying the wholesale and jobbing electrical trade, furnishing them supplies, bells, motors, lamps, switches, etc., at prices which prove it to be more economical for dealers and construction companies to have their specialties manufactured for them than to build these themselves. They are doing a good deal of model work for inventors, and in designing, draughting and the construction of new models, as well as in the re-designing of old devices, they have been very successful.

The Eureka Electric Company, 18 Broadway, this city, is equiping the steam yacht "Aztec" for Mr. John A. Loring with 100 incandescent lights of the Loomis system. A Huntington search light will also be installed. The same company will fit up the steamer "Naugatuck" with 75 lights. The dynamos will be driven by the Evans friction cone gearing in both of these boats, and also in connection with the Loomis system in the Vanderbilt Building, corner of Beekman and Nassau streets, in this city. A special feature of the Loomis system is the operation of both arc and incandescent lights in the same circuit.

Messrs. Woodbridge and Turner, 74 Cortlandt street, in this city, electrical engineers and contractors for the installation of electric light and railway plants, have completed this year or have now under construction 45 miles of electric railway operating over 50 cars. Most of these cars were built by the John Stephenson Company of New York. Messrs. Woodbridge and Turner are just beginning work on two new roads, one in Quincy, Ill., and one in Amsterdam, N. Y.; the two having 15 miles of track when finished will operate 21 cars. They are doing a very nice business in their track bonds of galvanized iron secured to the rails by iron rivets.

The New York Insulated Wire Company, 649 and 651 Broadway, New York, has issued a very complete and useful price-list and catalogue of the electrical supplies which it is offering to the trade. These include insulated wires, cables and tapes of various styles, Grimshaw patent "white core," insulating compounds, and telephone, telegraph and electric light wires of all kinds. The formulæ and tables which this little pamphlet contains are of use to every practical electrician who has almost daily use for data concerning the temperature coefficients, resistances, weight, etc., of various kinds of wire. The cover very artistic in design, in keeping with the contents of the pamphlet.

Mr. Chas. G. Armstrong, manager of the house goods department of the Great Western Electric Supply Company, of Chicago, has just returned form the East where he made arrangements for the handling of a superior line of goods throughout the Central and Western States. Thus his firm will have all the choice articles made by the National Electric Manufacturing Company, and the fine line of telegraph instruments as used by the Western Union Telegraph Company. The same firm is also the western agent for Brown's electric protector, which is intended to protect telephone circuits from the damaging effects of lightning and crosses. Rhumkorff coils and other scientific apparatus is now being imported by this company.

The Nordberg Manufacturing Company, Clinton and Osgood streets, Milwaukee, Wis., is placing on the market the Nordberg patent automatic combined trip cut-off gear, and a governor for controlling the same, designed to be attached to the steam inlet nozzle of slide valve and similar engines to regulate the speed of the engine. The steam is admitted at full boiler pressure, is cut of at a point corresponding to the demand of po er, and expanded. The resulting terminal pressure is said to be very much lower than if a throttling governor was used; consequently, less steam will be used with the Nordberg cut-off governor than with the throttling governor, as the terminal pressure is the measure of the steam consumed per stroke of the engine, while a good saving in fuel will be effected. Where electric light dynamos are used in isolated places this device will prove of value.

The Tripp Manufacturing Company, of Boston, has recently made a shipment of its celebrated anti-friction journal bearings to the Chicago and Northwestern Railroad for passenger service; also electric car tracks to the Concord Horse Railroad Company, Concord, N. H.; Wilkesbarre and Suburban Street Railway Company, Wilkesbarre, Pa.; Citizens' Cable Traction Company, Pittsburgh, Pa. The company is also at present manufacturing electric trucks for the following roads: West Side Street Railway Company, Milwaukee, Wis.; Citizens' Street Railway Company, Indianapolis, Ind.; St. Paul City Railway Company, St. Paul, Minn.; Tacoma and Stellacoon Railway Company, Tacoma, Wash.; Vancouver Electric Railroad and Lighting Company, Vancouver, B. C. The trucks manufactured by this company, equipped with Tripp bearings, because of their simplicity and durability are in great demand and are being rapidly adopted.

A Western Engineering Firm.—Among the new industries lately started is the Boughen Engineering Company, of Cincinnati, O. The business of this company is the construction and erection of steam power and water-works plants of all descriptions. The company is particularly well equipped for the class of work it is undertaking, and is prepared to do the work from first to last, without outside assistance and sub-contracting, as is necessary with an engineering concern of this description not having such facilities. Besides making a specialty of this work, this company is the general representative for the Central States of the following well known manufacturers: Taylor Manufacturing Company, Chambersburg, Pa., automatic engines; Hoover, Owens & Rentschler Company, Hamilton, O., Corliss engines; Abendroth & Root Manufacturing Company, New York, water tube boilers and spiral pipes; Murphy Iron Works, Detroit, Mich., patent smokeless furnaces; Gordon Steam Pump Company, Hamilton, O., steam pumping machinery; and for several others in different specialties. The company now has several large contracts under way, and has the most flattering prospects of success in the future. Although a new concern, the gentlemen composing it are all men of long practical experience in the different departments of which they have charge, and are full of push and business energy. They have comfortable and commodious offices in the Glenn Building, corner Fifth and Race streets, Cincinnati, O., where they are glad to see all who may be interested in their line of work.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest. All inquiries must be accompanied by real name and address, as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

The Westinghouse Railway Motor.—Can you give me the following information about these new motors? 1. What is the style of motor? 2. How is it connected to the axle? 3. What is the voltage of the circuit? 4. Is alternating or direct current used?

M. J. H.

1. In general appearance quite similar to those now in use. 2. Geared. 3. 500 volts or thereabouts. 4. Direct.

Transformers.—How could a constant current transformer be arranged on constant potential mains? SUBSCRIBER.

It would not be an easy matter to contrive such an arrangement as you wish. A constant potential secondary is nearly self-regulating on constant potential mains, but for constant current some special arrangement for regulation would be necessary. A choking coil of variable self-induction regulated by a solenoid in the secondary circuit would perhaps solve the problem. Such transformers are not used in practice, although constant current transformers are very successfully used on constant current mains.

Electrical Vehicles.—(1) Can you inform me where I can get a storage battery of power sufficient to run a carriage? (2) Can it be successfully applied to vehicles to take the place of horses?

A. N. N.

1. Consult our advertising columns for makers of storage batteries. You will find nearly any of them will answer your purpose so far as storing electricity is concerned. 2. We should not advise you to undertake rigging up an electric carriage, for the reason that unless you are very much favored in the matter of roads, the amount of power required and the weight of battery will be excessive. Electrical carriages have been made, but, as a rule, have not been very successful for these reasons. Your best chance is with a light road machine, like a tricycle, where the power required will be rather small, and you are consequently more likely to have good success. Mr. Slattery, of the Fort Wayne Electric Company, has conducted some interesting experiments with vehicles of this kind.

Business Notices.

The Battery Cut-Out sold by the Electric Supply Company of Syracuse, N. Y., 105 South Warren street, is cheap. Thoroughly tested, it is giving complete satisfaction. It automatically prevents the short-circuiting and damaging of gas lighting and other batteries. Send for circular.

Through Vestibuled and Colonist Sleepers Between Chicago and Tacoma, Wash., and Portland, Ore.—The Wisconsin Central and Northern Pacific lines run through Pullman vestibuled and colonist sleepers between Chicago and Tacoma, Wash., and Portland, Ore. The train known as the "Pacific Express" leaves the Grand Central Passenger Station, at the corner of Fifth avenue and Harrison street, at 10:45 P. M. daily. For tickets, berths in Pullman or colonist sleepers, etc., apply to Geo. K. Thompson, city passenger and ticket agent, 205 Clark street, or to F. J. Eddy, depot ticket agent, Grand Central Passenger Station, corner Fifth avenue and Harrison street, Chicago, Ill.

NEW YORK, April 30, 1890.

The Litofuge Manufacturing Company, New York City.

GENTLEMEN: During the past year, while superintendent of the Spanish-American Light and Power Company, in the City of Havana, Cuba, which electric plant consists of 4,500 incandescent lamps and 600 arcs, with four 15 h. p. Hazleton boilers, owing to the water in that city used for the boilers containing a large per cent. of magnesia and other substances, I was much troubled with the scale that formed in tubes and on plates, causing considerable expense for labor to clean the boilers. Since using your compounds, both A and B, the result has been very satisfactory, the boilers now simply requiring washing and the mud taken out in the usual way. I made careful examination of the plates to see if they had become pitted in any way, but could not detect the slightest ill-effect. I shall not hesitate in recommending your compounds where water is at all impure.

Yours very truly,

(Signed) WILFRID H. FLEMING,
Member Institute Electrical Engineers.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. Patents granted July 22, 1890.

432,521. Electric Cut Out; Stephen Dudley Field, of Stockbridge, Mass., Assignor of one half to Phœbus H. Alexander, of New York, N. Y. Application filed March 22, 1890. A safety catch or cut-out for an electric circuit, consisting of a tube of insulating material substantially filled with a vaporizable fluid conductor normally included in the circuit, in combination with a relief chamber communicating with the interior of the tube.

432,547. Telephone Exchange; John A. McCoy, of Medford, Assignor to the New England Telephone and Telegraph Company, of Boston, Mass. Application filed Jan. 23, 1888. In a telephone exchange, the combination of spring jacks having test pieces and a connecting cord and plug and movable sleeve surrounding the plug, with a central office telephone and contact points in circuit with said telephone and connecting cord and test pieces of the spring jacks and the ground, all controlled by said sleeve.

432,561. Brush Reverser for Electric Motors; Anthony Reckenzaun, of London, England, Assignor to the Electric Car Company of America, of Philadelphia, Pa. Application filed March 22, 1888. Patented in England May 1, 1885. The method of reversing the direction of rotation of an electric motor, consisting in first positively breaking the current which flows through the armature, then when no current is passing removing the brushes from the commutator, then applying the brushes to the commutator in the position for reversing, and finally closing the circuit through the armature.

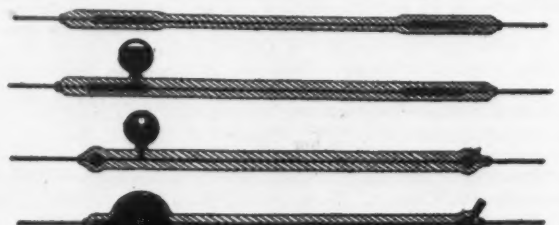
432,571. Conduit System for Electric Railways; Nicholas Seibert, of Malden, Mass. Application filed July 24, 1889. The conductor is placed against the roof of the conduit.

432,577. Dynamo Electric Machine; Henry W. Spang, of New York, N. Y. Application filed Nov. 13, 1889. The invention has reference to generators employing two armartures and having the pole pieces arranged in oblique relation to each other, and it consists in so constructing and arranging the armatures and pole pieces that the former shall revolve within the inductive field developed by lines of magnetic force emanating from the ends of the pole pieces and the adjacent regions of the field bars.

432,581. Frog for Overhead Wires; Elihu Thomson, of Lynn, Mass. Application filed May 5, 1890. The combination, with a branching line conductor, of a frog at the branching point, having a series of pins by which a contact device bearing on the said conductor is guided in the desired direction.

432,618. Electrical Communicating System; Alfred G. Holcombe, of Long Island City, N. Y., Assignor to the Electric Signal Manufacturing Company, of New York, N. Y. Application filed Jan. 6, 1890. The combination, of a normally closed circuit including a source of electric energy, and central station apparatus and sub-station apparatus in series, a resistance and magnet, normally included in the circuit at the central station and a normally open branch or shunt around the resistance and magnet and contact devices by which said shunt is closed when the main circuit is opened and the armature of the magnet retracted.

432,619. Call Box for Electrical Signaling Systems; Alfred G. Holcombe, of Long Island City, Assignor to the Electric Signal Manufacturing Company, of New York, N. Y. Application filed February 11, 1890. The combination, substantially as set forth, of the signal transmitting devices, the return signal magnet, the armature and cam-plate through which the coils of the magnet are normally shunted, the pivoted arm on the signaling wheel, and the arm deflecting bracket.



NO. 432,521.—ELECTRIC CUT-OUT.

432,623. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa. Application filed March 27, 1890. The combination of a source of electric supply, a traveling vehicle, an electric motor carried thereby, a shunt circuit upon the vehicle and receiving electricity from the same source as the motor, electric lamps in the shunt circuit, and an indicator to indicate the current flowing through said shunt circuit.

432,629. Electric Metal Working Apparatus; Herman Lemp and John Tregoning, of Lynn, Mass., Assignors to the Thomson Electric Welding Company of Maine. In an electric welding or metal working apparatus, the combination, with the sliding clamp, of a guide rest for the same having internal passages for circulation of a cooling medium.

432,630. Forming or Shaping Metals by Electricity; Herman Lemp, of Lynn, Mass., Assignor to the Thomson Electric Welding Company, of Maine. Application filed April 2, 1890. The improvement in forming or shaping metal, which consists in placing a piece of metal between two clamps or holders, passing a current from one clamp or holder through the metal, so as to heat the same, separating the heated metal in two pieces, interposing a former or shaping device between the heated metal ends, and then forcing the clamps or holders with the metal in place toward one another.

432,644. Current and Switch-Controlling Mechanism; Edwin Wilbur Rice, Jr., of Lynn, Mass. Application filed July 29, 1889. The combination with the electric controlling devices for an electric railway motor of a retractor tending to move such controlling devices into position to decrease the power of the motor to throw the same out of action, and a manually-operated actuator for such controlling mechanism constantly free to return to position of stoppage under the operation of such retractor.

432,645. Station Box for Watchmen's Time Detectors; James E. Richards, Cedar Keys, Fla. Application filed Sept. 10, 1889. The combination with a box provided with a cover having a slot therein, a rotatable reel for containing paper, a stationary flat tablet located adjacent to the slot in the cover when it is closed, rotatable paper feeding rollers and a paper-severing device in rear of the paper-feeding rolls.

432,646. Motor for Electric Railways; Michael Holroyd Smith, of Halifax, County of York, England. Application filed Oct. 29, 1887. Patented in England April 24, 1886; in Belgium Nov. 11, 1886; in France Nov. 20, 1886, and in Italy Dec. 16, 1886. The combination, with a car, of a motor, the magnets, yoke, an armature spindle of which all are in the same plane, the motor being supported in swinging bearings beneath the car.

432,651. Method of Working Metals by Electricity; Elihu Thomson, of Lynn, Mass. Assignor to the Thomson Electric Welding Company, of Maine. Application filed May 17, 1888. The herein described art of treating metal objects locally consisting in heating the part to be treated by an electric current of large volume passed through the same and surrounding the object with the desired treating substance, while the same is still heated by the current.

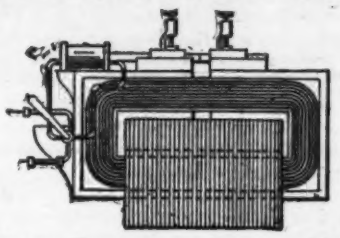
432,652. Welding or other Dynamo; Elihu Thomson, of Lynn, Mass. Application filed Jan. 22, 1889. The combination, with the revolving field magnet and stationary core or carrier, of a work supply conductor applied to said core and an exciter supply conductor, one part of which is applied adjacent to the first conductor and another to a part of the core more remote.

432,653. Method of Welding by Electricity; Elihu Thomson, of Lynn, Mass., assignor to the Thomson Electric Welding Co., of Maine. Application filed May 1, 1889. The process of forming a junction between sections of pipe tubing or other hollow metal articles, consisting in passing a current of electricity across the joint between the sections to heat the joint to the welding temperature and completing the welding operation over a mandrel introduced into the pipe or other article beneath the joint.

432,654. Electric Meter; Elihu Thomson, of Lynn, Mass. Application filed December 2, 1889.
For description see THE ELECTRICAL WORLD, Aug. 2, 1890.

432,656. Manufacture of Bands, Rings, etc., by Electricity; Elihu Thomson, of Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Application filed April 16, 1890. The improvement in manufacturing metal rings, bands, or other endless shapes of metal, consisting in making a blank of endless form by the electric welding process and subsequently swaging, rolling or pressing the blank, so as to produce the desired shape in cross section.

432,657. Electric Lighting of Railway Trains; Illius Augustus Timmis, of London, County of Middlesex, England. Application filed Dec. 26, 1889. In an electric lighting apparatus for railway trains, the combination of a main source of electricity



NO. 432,630.—FORMING OR SHAPING METALS.

main, positive and negative leads for a car communicating with the main source of electricity, a secondary battery for the car, a battery charging lead, connections between the battery and one of the main leads and the battery charging lead, a lamp for the car in electrical communication with the main leads and another lamp for the car in communication with that one of the main leads which is connected with the battery and in electrical communication with the battery charging lead and switch mechanism for the two lamp circuits.

432,670. Conduit Electric Railway; Byron Jennings, of San Jose, Cal. Application filed Jan. 18, 1890. A support for the conducting wire of an electric railway, consisting of clamps, fixed upon an insulator and having a curved or irregular groove into which the main portion of the wire is compressed, a channel upon the top of the clamp, and a supplemental wire extending over the depressed portion of the main wire and fixed to it at opposite ends.

432,672. Method of Making Secondary Battery Plates; William P. Kookogey, of Brooklyn, N. Y., Assignor to the Kookogey Electric Company. Application filed Dec. 28, 1889. The method of making secondary battery plates, consisting of placing a rigid frame of conducting material between two sheets of punctured or perforated lead, filling the frame with active material or material to become active, and fastening the sheets and frame together by burning.

432,673. Electric Railway; Frank Mansfield, of Melrose, Mass. Application filed March 26, 1887. Renewed June 17, 1889. The combination, in an electrical railway, of a subterranean conductor insulated throughout its length and extending from the main at intervals along the way, the circuit of which is normally broken, a series of movable members arranged along the way, to which said branch conductors are connected, circuit completing means for the branch conductors controlled by the movable members, an electro magnet carried by a car and circuit completing devices on said car with which the branch conductors make contact when the movable members are raised by the electro magnet.

432,675. Electrical Railway; Frank Mansfield, of New York, N. Y. Application filed April 12, 1890. In an electrical railway the combination of a pick-up on a car, a main conductor insulated at all points throughout its length, with normally disconnected branch conductors extending therefrom covered with insulating material, but having an exposed end, and mechanism operated by the pick-up for raising the exposed end of the branch conductors in contact with circuit-completing devices on the car.

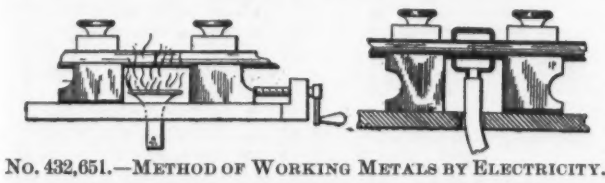
432,681. Battery Cell; Henry E. Waite, of New York, N. Y., Assignor to the Waite & Bartlett Manufacturing Company, of same place. Application filed May 6, 1890. In a portable battery the combination, with a hydrostat, of battery cells, the open ends of which are contracted to form narrow edges bearing against the hydrostat.

432,694. Apparatus for Indicating Races; George Henry Chappell, of New York, N. Y., assignor of one-half to Francisco Lavandeyra, of same place. Application filed Jan. 8, 1890. An apparatus for indicating or portraying the progress of a race or game, comprising miniature horses or other indicating figures, a motor continuously actuating them simultaneously and moving them all in the same direction and a magnet for each of said figures for stopping or retarding the movement of said figures independently or together.

432,707. Electric Motor; Henry Humbert, of Brooklyn, N. Y. Application filed Feb. 5, 1890. An electric motor having field magnets and provided with an armature consisting of a wheel or spider having flanges, a series of electro magnets having their axes in the plane of rotation and fitted to the flanges of the wheel or spider, and securing bolts passing through the flanges from the inside into the polar pieces.

432,710. Filament for Incandescent Electric Lights; Lawrence N. P. Poland, of Cincinnati, O. Application filed April 21, 1887. A filament of pure metallic iridium obtained by electro deposition.

432,724. Automatic Adjuster for Telegraph Lines; Courtland P. Carr, of Chicago, Ill. Application filed Nov. 26,



NO. 432,651.—METHOD OF WORKING METALS BY ELECTRICITY.

1889. In an automatic adjuster, an induction coil having its primary circuit cut into the local circuit of a relay in series with the sounder and its secondary circuit connected in series with a magnet.

432,727. Method of Electric Riveting; Mark W. Dewey, of Syracuse, N. Y. Assignor to the Dewey Corporation, of same place. Application filed April 24, 1890. The method or process of electric riveting, consisting in interposing insulating material between the pieces or plates to be riveted together, then inserting the rivet into the rivet holes and then passing a heating electric current through the rivet and plate to unite the sides of the rivet to the main body through which it passes.

432,745. Electric Lighting System; Edward T. Cooke and William H. Mackay, of St. Louis, Mo. Application filed Dec. 6, 1889. A pair of electrical switches having each two sets of conducting contacts and circuit connections between said contacts, and an electrical generator and a translating device, one contact only at each switch being connected directly to the traslating device.

432,748. Armature for Dynamo Electric Machines; Nathan H. Edgerton, of Philadelphia, Pa. Application filed Oct. 26, 1889. The invention has for its object to dispense with the disks of metal or plates and substitute a more inexpensive form of sectional core, which possesses all the practical advantages or functions of the disk form of same; and to this end I preferably use bat strips of metal, which are preferably coiled lengthwise upon the armature shaft and one upon another, and the ends of each coil are suitably fastened to the end caps of the core, and the succeeding coils are suitably insulated from one another.

432,752. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Conn. Application filed April 11, 1890. The combination of a railway track, a suspended conductor arranged along the track, a car running upon the track, an electric motor supported upon the axle of the car, a current collecting device carried by the car body and making contact with the suspended conductor, having its end adjacent to the conductor movable laterally, a motor circuit carried on the car connecting the current controlling device with the motor, and current controlling devices to control the current in said motor circuit.

432,753. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Co., of Connecticut. Application filed May 28, 1890. The combination with a railway, line conductors arranged along the railway for supplying electric current to an electrically propelled vehicle, a traveling vehicle, an electric motor carried thereby, a motor circuit carried by the vehicle making a traveling connection with the line conductors and supplying current to the motors, a shunt circuit upon the said vehicle receiving electricity from the same source as the motor, electric lamps in the shunt circuit, and an indicator to indicate the current flowing through said shunt circuit.

432,823. Magnetic Separator; George S. Finney, of Chicago, Ill. Application filed Nov. 11, 1889. A magnetic wheel for a separator, comprising a single magnet, having the poles extended from its opposite ends crosswise of the plane of its circumference and forming elements of its cylindrical surface.

432,834. Method of Forming Secondary Battery Plates; Henry G. Morris, of Philadelphia, Pa. Application filed July 22, 1889. The mode of forming plates for storage batteries, consisting in first forming a grid with partitions tapering to a thin edge and forming throughout the grid cells without any intervening supports for the active material, then spreading the active material over the entire plate, so as to fill the cells, and finally simultaneously compressing the active material, and the thin edges of the partitions, whereby the active material is compressed in the cells without material reduction in the area of the exposed faces of the bodies of active material.

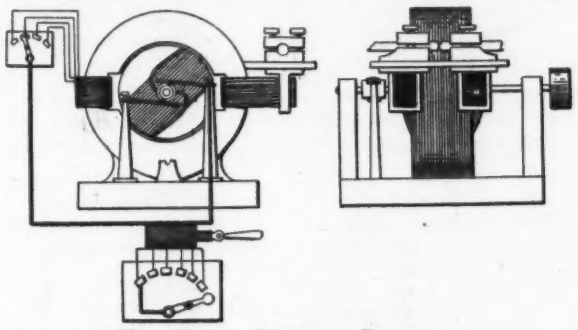
482,883. Support for Telephone Hearing Trumpets; Simon Lebenberg, of Berlin, Germany. Application filed March 31, 1890. A holder for telephone receivers, consisting of a horizontal jointed bracket mounted in vertical bearings on a fixed support, an upright movable vertically in the outer member of the bracket, and a horizontal arm provided at its outer end with vertical spring clamps and connected by a universal joint to said upright.

432,884. Electric Gas Lighter; Joseph H. Lehman, of Philadelphia, Pa. Application filed January 23, 1890. In an electric gas lighter, a movable electrode, in combination with another electrode with which it makes contact to produce a spark at the burner tip, mechanism for operating said movable electrode to make contact in its forward movement, mechanism for preventing such contact in its backward movement, and devices to prevent its movement, at each alternate operation.

432,894. Rheostat; Thomas J. Parrish, of Nevada, Missouri. Application filed February 14, 1890. Consists in the peculiar construction and arrangement of a base piece, a helical coil having a hollow central chamber, a supporting bracket for the same, and a slide arranged to move into or out from the coil and provided with an external spring adapted to bear upon different portions of the exterior of the coil to transmit the current through more or less of the coil, according to the will of the operator.

432,896. Drill Hole Magnet; Charles Sanders Porter, of Ivanhoe Furnace, Va. Application filed March 28, 1890. The invention consists in a permanent bar magnet, flattened at one end and perforated, in combination with a chain having one of its links inserted in the perforation of the magnet.

432,932. Heating by Electricity; Watkins Leigh Burton, of Richmond, Va., Assignor to the Burton Electric Co., of same



NO. 432,652.—WELDING DYNAMO.

place. Application filed Dec. 23, 1889. The invention consists in supplying a very strong current to each heater until the same becomes very hot and then supplying a reduced constant current to all the heaters, which will be sufficient to maintain the temperature developed for a long time, so that the temperature of the heaters remains nearly constant.

432,944. Conduit Electric Railway; Byron Jennings, of San Jose, Cal. Application filed Feb. 6, 1889. In aconduit electric railway, the rails having downwardly projecting tongues or flanges and overlapping meeting ends secured by fish plates, in combination with slotted chairs with insulated material within which the tongues upon the rails are fitted and secured.

432,949. Arc Lamp; Austin H. Lucas, of Pittsburg, Pa. Assignor of one-half to Asaph T. Rowland, of same place. Application filed May 1, 1890. This invention consists in a lock mechanism operated to lock the second carbon rod in an elevated position by the upward movement of the first carbon rod when trimming the lamp, and operated by the first carbon rod when it reaches the lower limit of its movement, to release the second carbon rod and permit of its being fed in the usual manner.

PATENTS ISSUED JULY 29, 1890.

432,965. Electric Light Fixture; Fred H. Aldrich, of Cadillac, Mich. Application filed Sept. 16, 1889. The combination of a vertically perforated shaft having a slot in one side, the electric light fixture at the lower end of said shaft, the conducting wire extending through the perforation and slot in the latter, and spring actuated mechanism for automatically winding the wire around the said shaft.

432,973. Galvanic Battery; Horatio J. Brewer, of New York, N. Y. Application filed April, 1890. A battery cover consisting of two separate pieces, one a removable central piece of insulating material supporting one element, and the other a rim of conducting material forming a support for the removable central piece and for the other element.

432,978. Electric Cut-Out; Henry A. Chase, of Boston, Mass. Application filed March 27, 1890. In an electric cut out, an electromagnet and its armature, combined with a gravity shunt circuit closer, comprising a movable member held in position to be released by the armature, and two pens included in circuit with the instrument to be protected, one at each side thereof, with which the said movable member co-operates, and fuse wires included in the line near the pens.

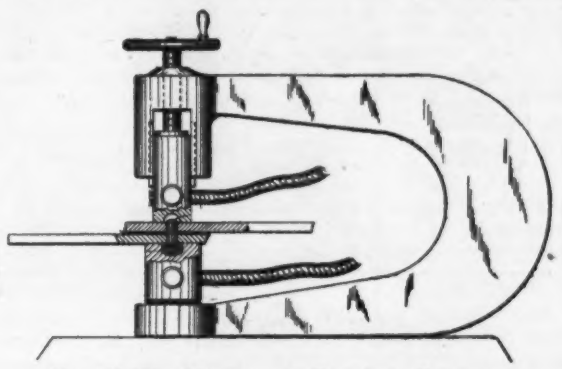
432,979. Electric Cut-Out; Henry A. Chase, of Boston, Mass. Application filed March 31, 1890. The invention consists of a wedge block made of rubber or other insulating material, is held in elevated position by the armature of the electro-magnet, and the contact pens normally touch each other, so that a continuous current passes through them; but when the wedge block falls it enters between the contact pens, thus breaking the circuit and at the same time preventing the formation of an arc between the pens.

432,980. Fuse Block and Lightning Arrester; Henry A. Chase, of Boston, Mass. Application filed March 31, 1890. The lightning arrester comprises two supports or posts having pointed arms which terminate adjacent to the fuse wire supports, the said posts or supports being connected with a suitable post, which may be connected with a ground terminal. Separating or bridge walls are arranged between the fuse wire supports and also between the supports and arms of the lightning arrester.

432,988. Automatic Electric Switch and Cut-Out; Charles B. Doyle, of Maywood, Ill. Application filed Nov. 18, 1889. The combination, with the mains supplying a motor, of a switch lever carrying contacts insulated from the lever and connected by a fusible wire, the field and armature of the motor and contacts or brushes with which the contacts upon the lever are adapted to be closed to bring the motor into circuit.

433,022. Electro-Magnetic Cut-Out; Bernice J. Noyes, of Boston, Mass. Application filed February 5, 1890. In an electric cut-out, an electro-magnet, its armature, and a gravity circuit breaker, combined with two normally contacting pens included in the circuit at one side of the instrument to be protected and two normally contacting pens included in the circuit at the other side of the instrument to be protected, said circuit breaker when falling separating said pens to thereby break the continuity of the circuit at two points.

433,025. Conduit for Telegraph Cables; William B. Patterson, of Chicago, Ill. Assignor to the Western Electric Company, of same place. Application filed July 18, 1887. The combination, with the angular manhole of an underground



NO. 432,727.—METHOD OF ELECTRIC RIVETING

electric cable system, or conduits connected with the manhole at opposite angles and cables laid in said conduits and bent to conform to the sides of the manhole, whereby space is afforded for splices on opposite sides and all unnecessary bending of the cable avoided.

433,041. Electrode for Arc Lamps; Llewellyn Saunderson, of Kingstown, County of Dublin, Ireland. Application filed May 14, 1890. Patented in Belgium Feb. 20, 1890, and in Italy March 31, 1890. In an arc lamp, the combination consisting of carbon electrodes (one or both hollow) connected with an electric source and usual devices for the production of the electric arc between electrodes, a tightly fitting fibrous plug inserted a short way up the hollow electrode, a thread of asbestos or refractory fibrous material loosely placed in a space within the electrode between the fibrous plug or packing at one end and the arc at the other, and means for supplying liquid hydrocarbon to the plug or packing at the end farthest away from the arc.

433,045. Safety Cut-Out; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed April 28, 1884. In a telephone line circuit the combination with a fusible wire and an annunciator included in the circuit, a switch or circuit closer connected with the line circuit, said switch or circuit closer being held in open circuit by said fusible wire, a generator or battery connected wih the contact point of the switch or circuit closer, whereby the generator or battery is automatically closed through the annunciator when the wire is fused.

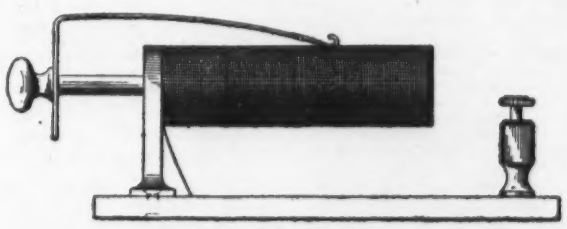
433,046. Loop-Key; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed March 13, 1885. The combination with insulated contact springs forming the terminals of a loop circuit, and normally resting upon insulated contact points of the plunger placed between the springs and serving as a wedge, when depressed, to separate the springs and form electrical connection with one of the springs during all the time the spring is lifted from its contact point.

433,047. Test Circuit for Multiple Switch Boards; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company of same place. Application filed June 6, 1888. A testing apparatus consisting of a battery and an electro-magnet provided with two windings, one of a small number of convolutions and the other of a large number of convolutions included in a ground circuit, a shunt around the high resistance coil, including the armature lever and the flexible cord and terminal plug of the circuit.

433,051. Dynamo Electric Machine; Henry W. Spang, of New York, N.Y. Application filed Nov. 13, 1889. A dynamo electric generator or motor having an armature arranged within and subject to the influence of two or more opposing pole pieces of the same width, the core of the armature being extended so as to penetrate the field beyond each end of all the pole pieces.

433,082. Dynamo Telegraphy; Francis W. Jones, of New York, N. Y. Application filed June 11, 1889. In an electric switch, the combination with the spring jack of a supplemental switch connected to the normally open contact point and arranged upon insertion of the wedge, to place in circuit generators of varying potential and one or more wedges to which are connected loops, relaying circuits and branch circuits, arranged to automatically cut out grounds and extend the circuit.

433,120. Telephone; Stephen D. Field, of Yonkers, N. Y. Application filed June 21, 1887. The invention consists in constructing an apparatus which automatically makes and breaks an electric circuit with a rapidity too great for its effects to be appreciated by the ear, and in so combining the apparatus with a diaphragm that sound waves projected against the same are caused to bridge over more or less of the makes and breaks of the



NO. 432,894.—RHEOSTAT.

circuit in proportion to the rapidity with which the sound waves succeed each other.

433,167. Apparatus for Detecting Irregularities in Railroad Track; James Bolan Glover, of Marietta, Ga., Assignor of one-third to John Malloch, of Elderslie, Scotland. Application filed April 14, 1890. The invention consists in the combination, with pipes through which colored fluid or matter from a proper receptacle can be discharged onto the sides of the roadbed or ends of the sleepers, of electrically controlled valves, which are operated automatically to regulate the discharge of fluid, so that it escapes only upon defective portions of the track and at the defective side thereof.

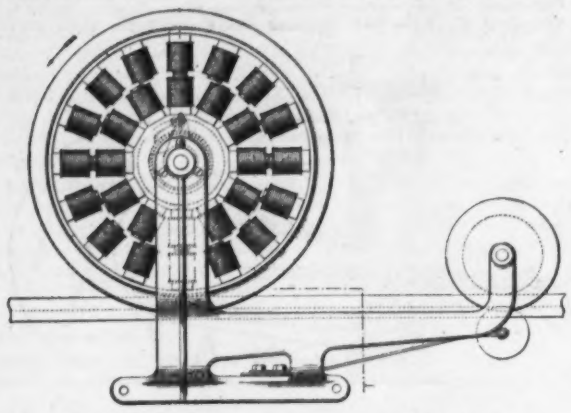
433,170. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa, Assignor to the Electric Car Company, of America, of same place. Application filed March 26, 1890. The combination, in an electrically propelled vehicle, of a truck or car frame, an electric motor carried thereby, a source of electrical energy, a motor circuit for supplying electricity to the motor, a derived circuit in multiple with the motor circuit, one or more circuit breakers or switches in the derived circuit and a position indicator in and operated by the current in said derived circuit to indicate which circuit breaker or switch is operated.

433,174. Separator for Secondary Batteries; William P. Kookogey, of Brooklyn, N. Y., Assignor to the Kookogey Electric Company, of same place. Application filed March 10, 1890. A separator for secondary batteries, made of hard rubber or other insulating, non-oxidizable, and non-contractile material in one or more parts and passing entirely around the plate.

433,180. Electro-Motor Traction Wheel; Albert L. Parcelle, of Boston, Mass., Assignor to the Florence Motor Company, of Maine. Application filed Aug. 14, 1889. The combination of the revolving axle, the wheel fixed thereon, its overhanging or flanged rim, the series of groups of armature magnets radially and circumferentially mounted on the inner side of the rim, a

non-rotating hub or frame carrying a corresponding series of smaller groups of field magnets radially, circumferentially, and concentrically arranged within the other groups in the same vertical plane, a commutator revolving with the hub against a brush fixed on the frame, a stationary commutator mounted on the fixed part of the frame, a brush carried by the rotating hub.

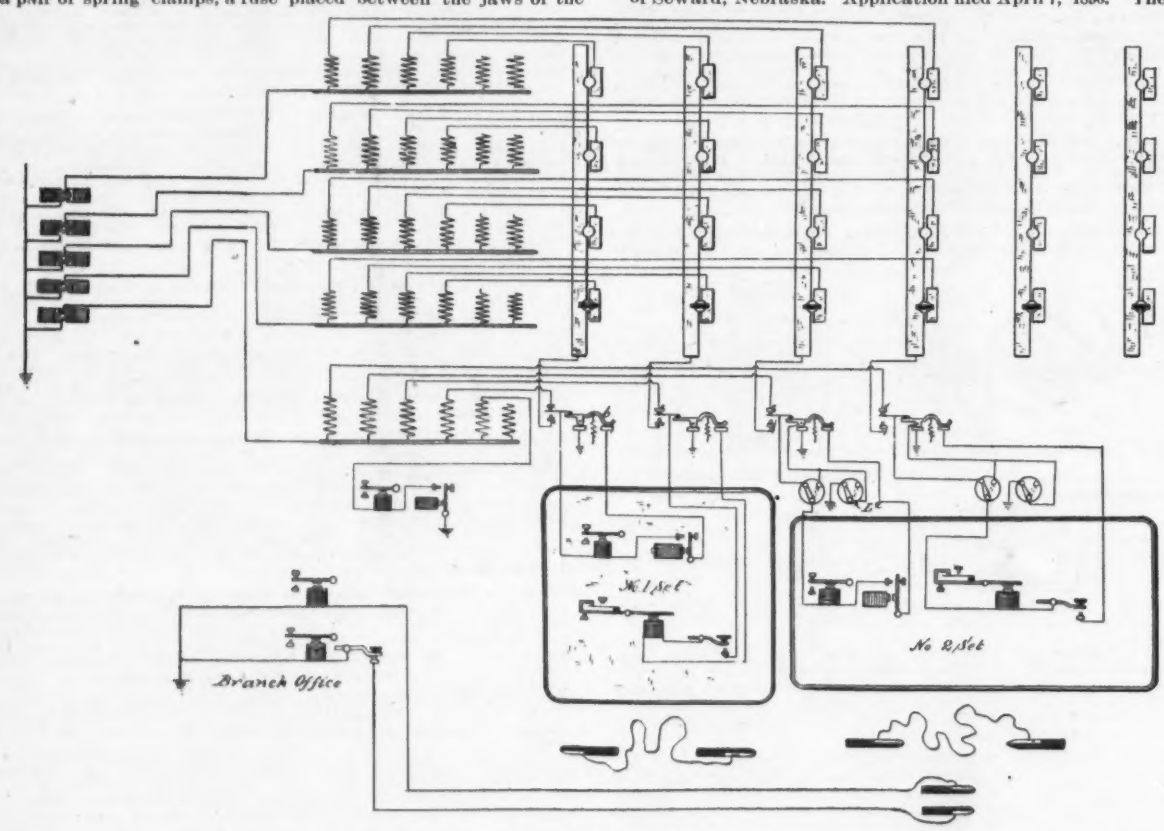
433,181. System of Electrical Transportation; Albert L. Parcelle, of Boston, Mass., Assignor to the Florence Motor Company, of Maine. Application filed Aug. 16, 1889. The combination of the hanger frame, the axle fixed therein, the electro-motor traction wheel turning loosely thereon, the elevated rail or support on which the wheel travels, the depending car supporting frame, the overhanging or flanged rim of the motor wheel, the series of groups of armature magnets radially and circumferentially mounted on the inner side of said pin, the commutator on



No. 433,181.—Electrical Transportation.

the rim, its stationary brush, the non rotating hub or fixed frame, the corresponding series of smaller groups of field magnets, radially circumferentially, and concentrically mounted on said hub within the armature magnets, the commutator on the fixed frame, its brush carried by the wheel and circuit connections to shift the currents successively through the corresponding magnets of each group, to produce a continuous pull on the magnets without intervening gearing.

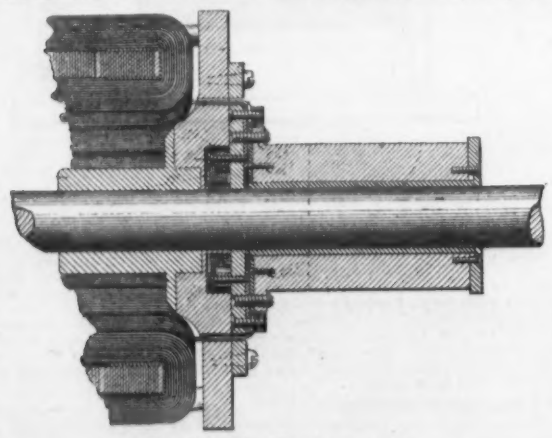
433,187. Safety Cut-Out; Marshall S. Shapleigh, of Philadelphia, Pa. Application filed Dec. 17, 1889. The combination of a pair of spring clamps, a fuse placed between the jaws of the



No. 433,082.—Dynamo Telegraphy.

clamps and automatically clamped thereby, and terminals provided with lateral supports operating to compress the jaws of the clamps externally.

433,210. Electric Apparatus for Railways; John B. Odell, of Chicago, Ill. Application filed April 4, 1890. The combination, with the car axle and the pulley and belt for transmitting motion thereto, of a movable motor having two armatures and magnets for the armatures and commutators adapted to cause the armatures to revolve in like direction, and a pulley located



No. 433,393.—Commutator.

on the armature shaft intermediate the armatures, and suitable means for moving the motor back and forth.

433,216. Automatic Electric Train Signal; Albert W. Reppy, of Oakland, Cal., Assignor of one-half to Thaddeus C. Masteller, of same place. Application filed Jan. 14, 1890. In an electric train signal apparatus, the combination of an abnormally closed main line circuit extending throughout the train and including electro-magnets, normally open local circuits at points throughout the train, alarm mechanisms adapted to be operated by said local circuits when closed, and a circuit maker and breaker controlled by the main line circuit for keeping open its local circuit when the main line circuit is closed and closing the said local circuit when the main line circuit is open, whereby the alarm mechanism is operated.

433,229. Thermal Cut-out; Alexander Bernstein, of London, County of Middlesex, England, Assignor by mesne and direct assignments to the Bernstein Electric Company, of Boston, Mass. Application filed July 28, 1888. In an electric switch or cut-out, two conducting pieces or parts, one of which is movable with relation to the other, combined with conducting material which offers considerable resistance to the current which always diffuses freely through it, said conducting material being interposed between the said conducting pieces, and by local heating releasing the movable conducting piece.

433,269. Regulator for Dynamo Electric Machines; Perley P. Belt, of Grodonia, Kansas. Application filed April 9, 1890. In a regulator for dynamo electric machines, the combination, with a dynamo provided with a commutator cylinder, of an electric motor connected with the commutator cylinder and arranged in the dynamo circuit, so as to tend to revolve by the current in a direction opposite to the rotary motion imparted to it by connection with the commutator cylinder.

433,307. Telephone Call Register; Willis Eugene Robinson, of Farribault, Minn. Application filed Feb. 15, 1889. The invention consists in the combination with a train of spring-actuated gearing provided with a stop motion, of an electro-magnetic releaser for starting the train, a dial for recording the number of separate movements of the train, and mechanism for permitting of the winding of the driving spring without disarranging the other parts of the apparatus.

433,359. Rheostat-Switch; James F. McLaughlin, of Philadelphia, Pa. Application filed Dec. 4, 1889. In a rheostat switch, the combination of a series of segmental contact blocks and a switch lever carrying a spring seated brush block in operative relation to the contact blocks, with a notched segmental plate, and a spring seated stop tooth carried by the switch lever for engaging the notches, and thereby locking the lever in position.

433,360. Electric Switch; James F. McLaughlin, of Philadelphia, Pa. Application filed April 16, 1890. An electric switch consisting of a reciprocating carriage having series of contact plates on opposite faces and spring-actuated contact blocks in operative relation thereto.

433,371. Holder for Incandescent Electric Lamps; Adolf Schirner, of Berlin, Germany. Application filed March 31, 1890. In a holder for incandescent lamps, the combination of a sleeve made of a resilient sheet metal and with screw threads embossed thereinto, the said sleeve being provided with longitudinal slits whereby it is divided into segments, and a spring or springs acting on the said segments.

433,381. Electro Magnetic Transmitter; John T. Williams, of Mount Vernon, N. Y., assignor to the International Port-Electric Company, of New York, N. Y. Application filed Oct. 24, 1889. The combination, with a series of helices, a track extending through the helices and a carriage of a series of regular circuit closers and a series of supplementary circuit closers, all actuated by the advancing carriage and connections between the circuit closers and the helices with a generator of electricity.

433,384. Electrical Syringe; James Harrison Woodward, of Seward, Nebraska. Application filed April 7, 1890. The combination, with a syringe having a metallic nozzle forming an electrode, of a tube formed with or secure to said syringe and extending from end to end thereof, and an electric conductor passing through said tube and connected with said electrode.

433,390. Brush Holder for Electrical Machines; Warren S. Belding, of Englewood, Ill. Application filed July 5, 1889. In a brush holder for electric motors and dynamos, a body, seated upon a supporting arm and having upward directed slotted lobes to receive the brush, and a screw seated in the body below the space occupied by the brush, so that when the brush is inserted in said lobes the retraction of the screw from its seat will drive said screw upward against the brush and bind the latter in the slots of said lobes.

433,391. Armature for Dynamos, etc.; Warren S. Belding, Englewood, Ill. Application filed July 8, 1889. In an armature, the combination, with the armature ring and its shaft, of bolts extending through said ring between the coils, thimbles applied over said bolts at one end of the armature, of a length equal to the thickness of said coils, a spider applied to said shaft and extending over the bolts at that end of the armature ring and bound by nuts or equivalent means against or close to said coils and against the thimbles, and having openings around the shaft and thimbles, applied to said bolts at the opposite end of the ring of greater length than the thickness of said coils.

433,392. Blank for Armature Coil Guards; Warren S. Belding, of Englewood, Ill. Application filed Nov. 2, 1889. A blank of sheet metal or other suitable material for coil guards for armatures, such blank consisting of a web and lobes extending outward from opposite sides of the web, and being extended beyond said web a distance substantially equal to their own width, and there being a space between the lobes equal to the width of the bobbin space to which the guard to be formed from such blank is to be applied.

433,393. Commutator for Dynamos; Warren S. Belding of Chicago, Ill. Application filed January 30, 1890. In an electric motor or dynamo, a shaft, and insulation spider mounted upon the shaft, an armature ring supported at one end by the spider, a series of keystone plates arranged upon the face of the spider around the shaft, each such keystone plate being connected electrically with the coil of the armature, and a commutator surrounding said shaft and having one end resting near or against said keystone plates and having each commutator plate connected electrically with a kestone plate.

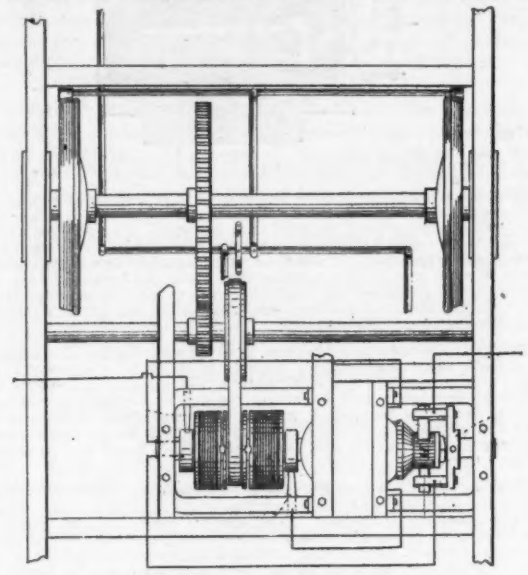
433,400. Magnetic Coupling Device; Theodore M. Foote, of Boston, Mass. Application filed July 18, 1889. The combination of a dynamo electric motor, mechanism driven thereby, and an electro-magnetic friction clutch disposed in the motor circuit, one member of said clutch being connected with the armature shaft of the motor and the other member thereof with said mechanism.

433,401. Variable Speed Gearing for Electric Cars; Theo. M. Foote, of Boston, Mass. Application filed Nov. 6, 1889. The combination of a dynamo electric motor mechanism driven thereby, two collars fixed to rotate on the motor shaft, two collars loose on the shaft, each of the collars being geared to the mechanism, magnetizing coils on two of the said collars, electric circuits connected with the coils, and a circuit changer for shifting the current from one circuit to the other.

433,402. Reversing Gear for Electric Cars; Theodore M. Foote, of Boston, Mass. Application filed Nov. 6, 1889. The combination of a dynamo electric motor, two sets of magnetizable collars on the motor shaft, one collar of each set being loose on the shaft and the other being fixed to rotate therewith and adapted to slide longitudinally thereon, and one collar of each set being provided with a magnetizing coil, elertric circuits passing through the coil, a switch for changing the current from one set of collars to the other set, a countershaft provided with two gear wheels, one of which gears directly with one of said loose collars, and an intermediate gear which gears with the other of said gear wheels and with the other of said loose collars.

433,407. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed May 7, 1890. The combination of a railway, a suspended conductor extending along the railways, an electrically propelled vehicle, and a current collecting device extending between the vehicle and conductor, consisting of a primary part movably connected to the vehicle, and a secondary part adjustably supported by the primary part, and carrying an under contact at its free end, making a moving contact with the under side of the conductor.

433,408. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed June 20, 1890. The combination

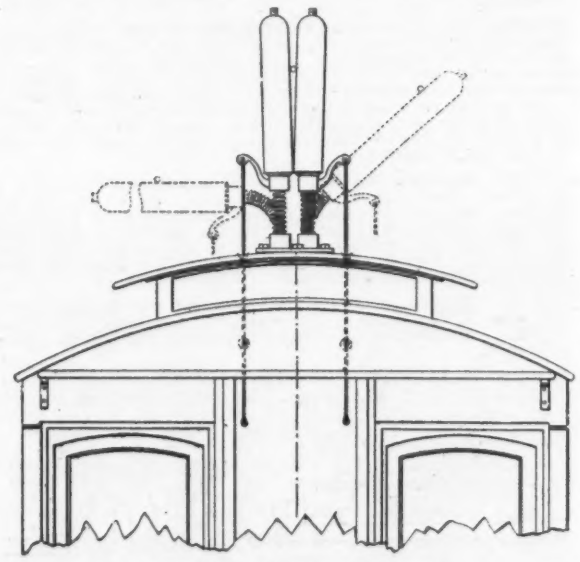


No. 433,400.—Magnetic Coupling Device.

of a railway, line conductors extending along the railway for supplying current to the car, a traveling car, an electric motor to propel the car, a motor circuit, including the said motor and making the traveling connection with the conductors, an indicator in view or hearing of the operator or conductor, a circuit including the indicator and receiving current from the same source as the electric motor, and a switch in the indicator circuit located within the car body and adapted to be located by the passengers.

433,409. Electric Railway; Herbert R. Keithley, of Denver, Colo. Application filed Feb. 17, 1890. In an electric railway, the combination of a continuous insulated supply conductor with copper contact pulleys and spindles and glass insulating supports, all enclosed in a slotted conduit.

437,421. Telegraphic Circuit; Arthur C. Robbins, of Brooklyn, Assignor to William S. Andrews, of New York, N. Y. Application filed April 6, 1887. In an electric circuit having a current at all times, and when a decreased or increased current is used for signaling, the combination of two automatic grounding devices at each station, each device arranged to act independently of the other, and each device consisting of an electro-magnet, an armature controlled by the magnet and arranged to press against a grounded stop when no current is passing through the



No. 433,425.—Contact Device.

magnet, and a resistance coil arranged to connect said grounded stop with the earth.

433,424. Combination Telephone Key, Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company' of same place. Application filed April 17, 1890. The invention consists in providing a grooved wedge and two studs or separating pieces of insulating material and a knife edge contact point upon one of the springs.

433,425. Contact Device for Electric Railways; Frank J. Sprague, of New York, N. Y., Assignor to the Sprague Railway and Motor Company, of same place. Application filed July 2, 1889. In an electric railway, the combination, with a car and a stationary conductor, of a contact device consisting of two flexibly supported and independently movable arms secured to the car at one end and free at their other ends, and making contact on their sides with opposite sides of the conductor.

433,430. Lightning Arrester; Alexander Wurts and Oscar H. Baldwin, of Pittsburgh, Pa., Assignors to the Westinghouse Electric Company of same place. Application filed July 1, 1889. The combination, with a generator of alternating electric currents, of a lightning arrester connected with the circuit of a generator, and a self-adjusting reacting device connected in the circuit of the arrester, and consisting of a core and a surrounding solenoid movable with reference to each other under the influence of current traversing the coil, for increasing the coefficient of induction under the influence of the current traversing the the arrester.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1886—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.